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Canadian Mining Review

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Vol. XII.—No. 1. 1893—OTTAWA, JANUARY—1893. Vol. XII.—No. 1.

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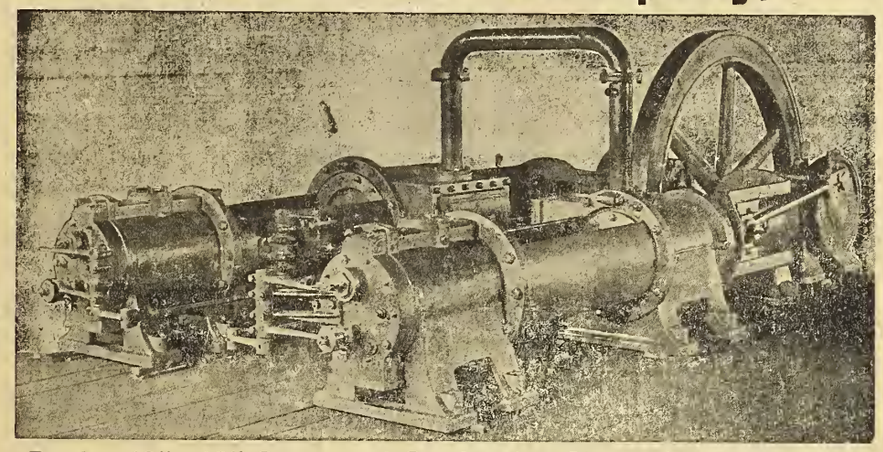

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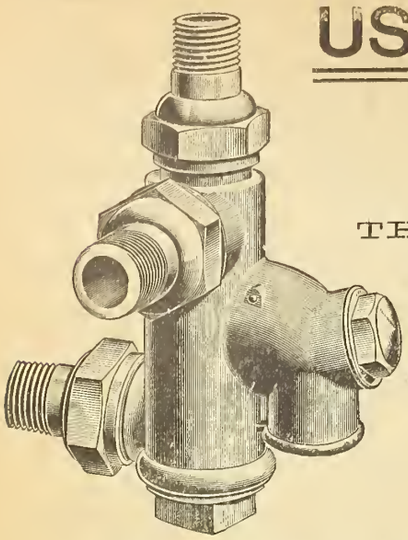
Dawson, Symmes & Ussher, Amherst, N.S., (Nine Eng'es.)
J. A. Munford, Hantsport, N.S., (Four Engines.)
West Waverley Gold Co., Waverley, N.S., (One Engine.)
The International Coal Co., Westville, N.S., (One Engine.)
The Caledonia Coal & Ry. Co., Glace Bay, C.B., do
The International Coal Co. Ltd., Sydney, C.B., do

☞ Others furnished on application. ☜



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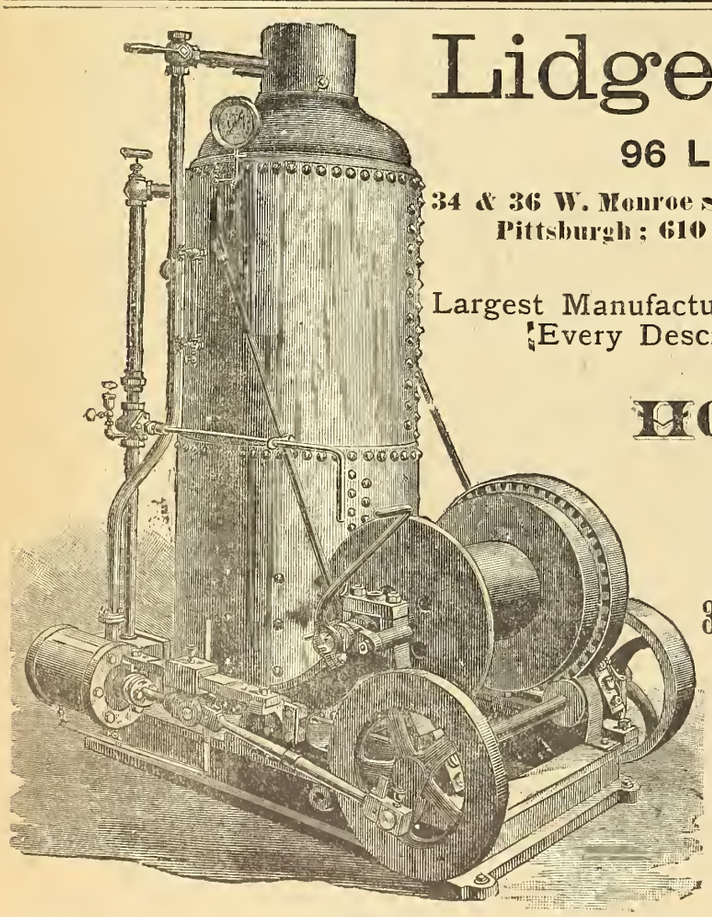

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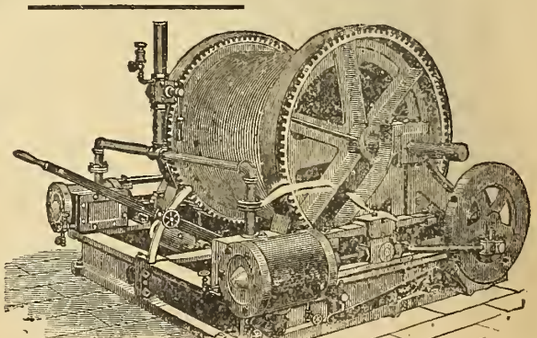

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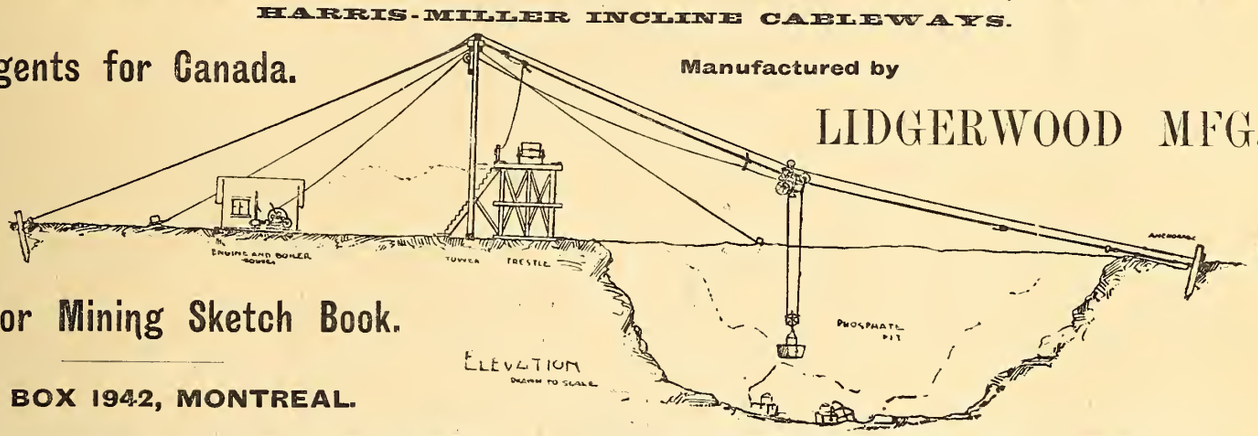

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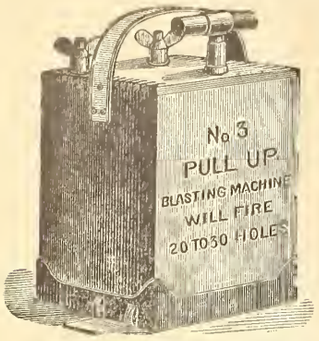

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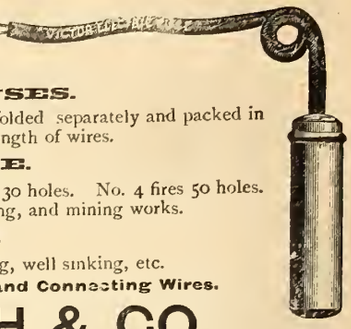

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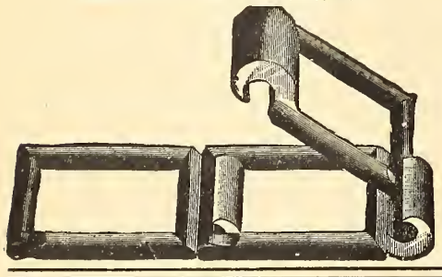

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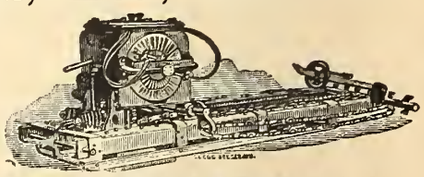

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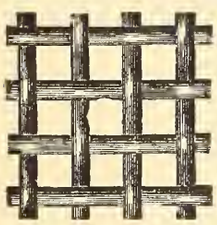

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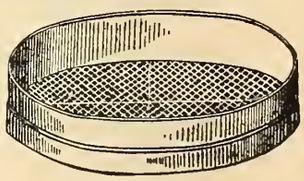

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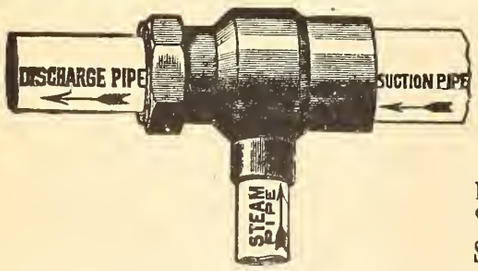

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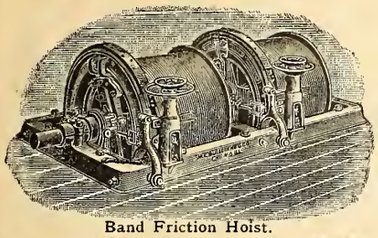

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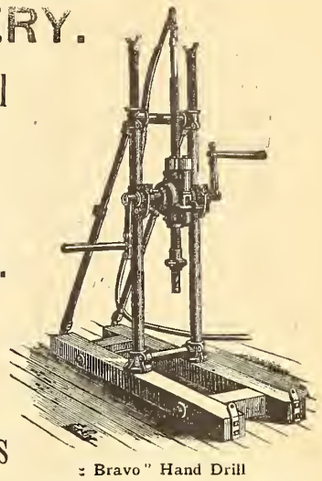

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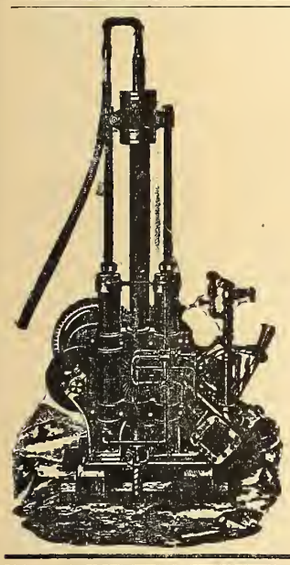

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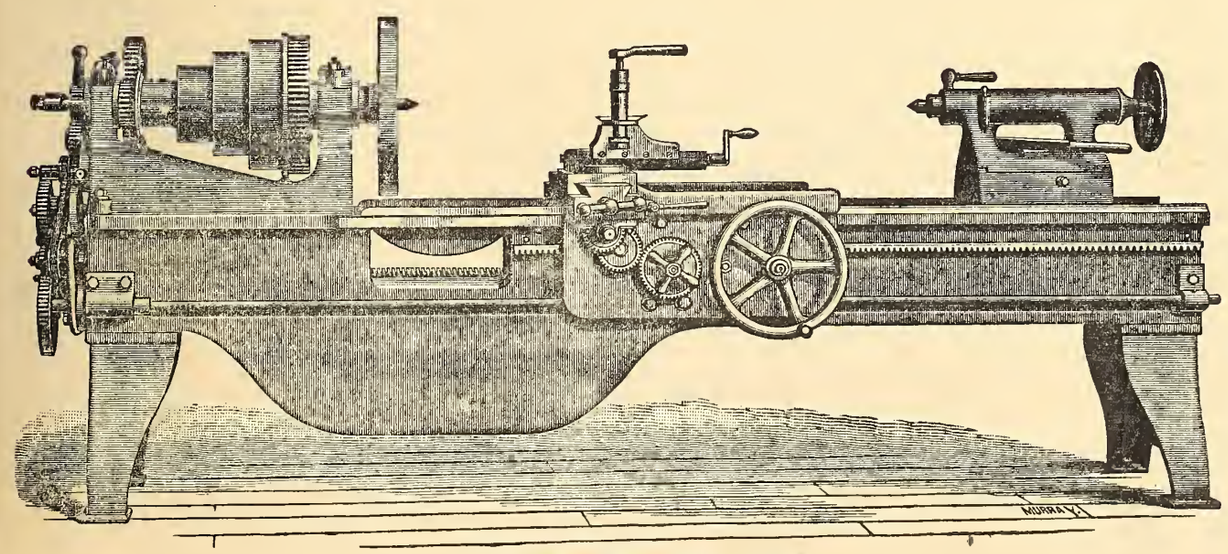

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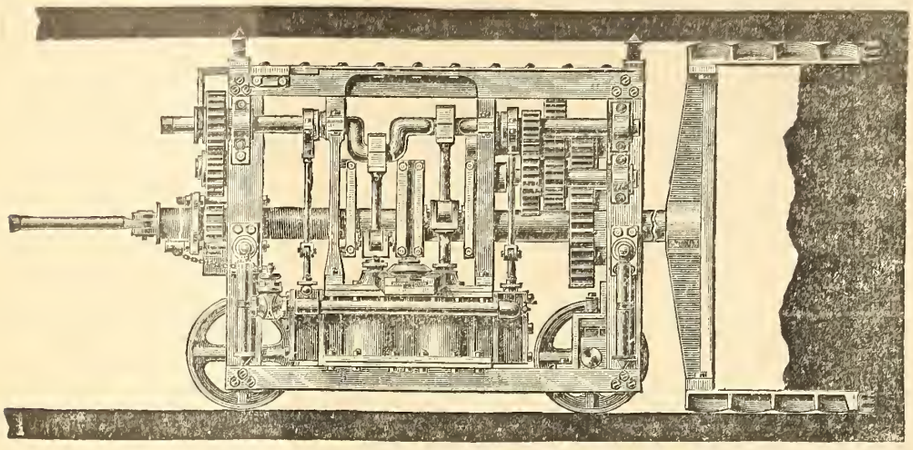

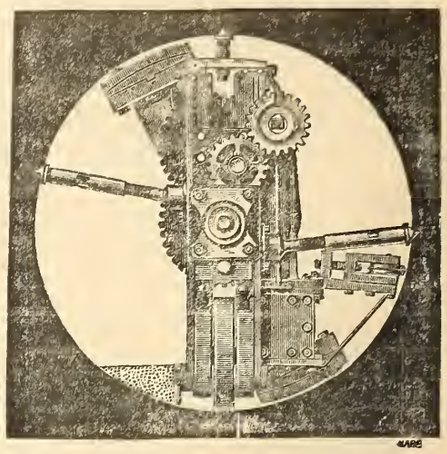

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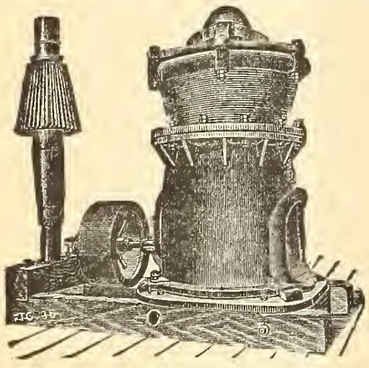

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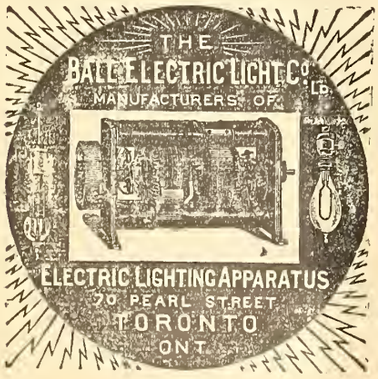

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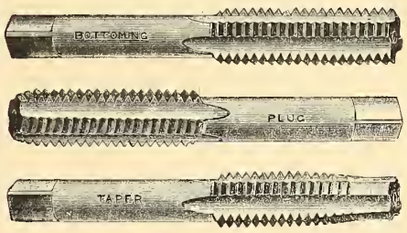

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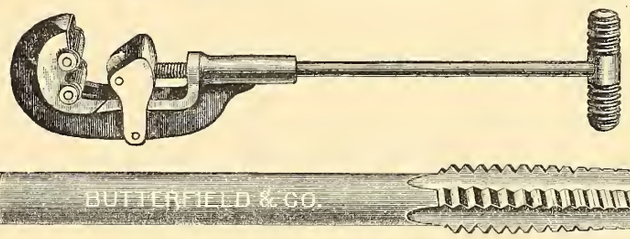

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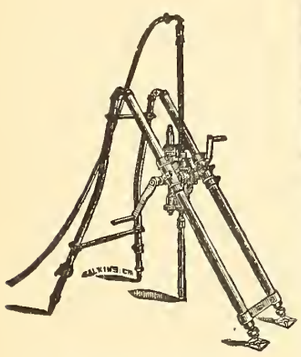

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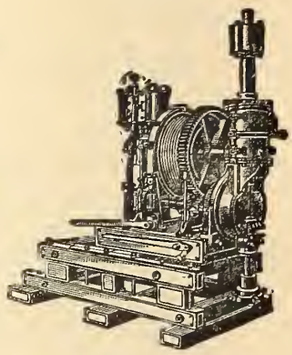

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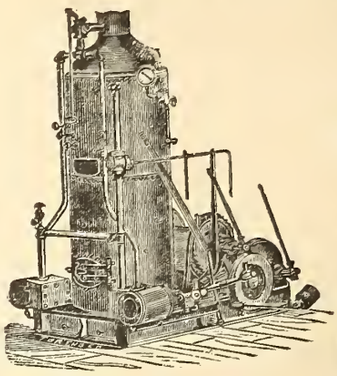

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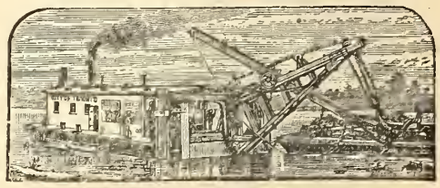

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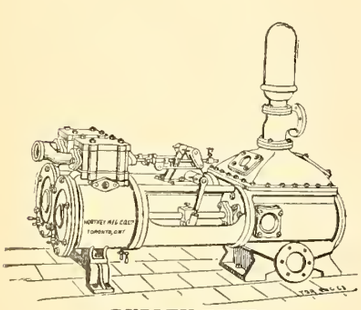

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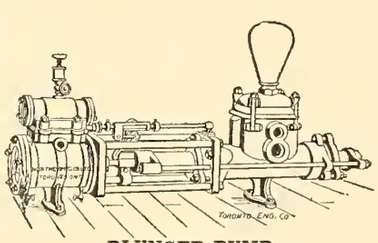

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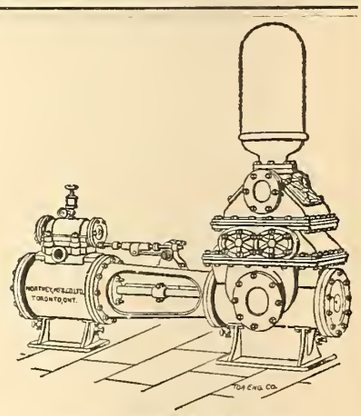

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CANADIAN MINING & MECHANICAL REVIEW

CONDUCTED BY - - - - - - B. T. A. BELL.

THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERAL MINING ASSOCIATION OF QUEBEC.

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries :—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

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Victoria Chambers, 140 Wellington Street,

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Vol. XII. JANUARY, 1893. No. 1.

Review of the Gold Mining Industry of Nova Scotia in 1892.

Pending the issue of the official figures the best estimate places the yield of gold for 1892 at 22,000 ounces, as against 23391 for 1891.

About four-fifths of this product is from the six districts of Oldham, Caribou (Moose River), Stormont, Malaga, Montagu and Uniacke—each having a yield in excess of 2,000 ounces.

The district giving the largest production was Oldham, with a total of 3,100 ozs, mainly (2944 ozs.) the product of one firm. This is the largest yield in the history of this district which has steadily increased its product each year from a total of only 824 ozs. in 1884, to 3100 in 1892.

Caribou and Moose River (which, although six miles apart are included in the one district) have a total yield approximating 3000 ounces, of which Caribou has about two-thirds and Moose River one-third.

The Dixon Mine, though not a heavy producer, is a very steady one, and is likely to continue its normal production throughout the year. The importance of the discoveries made in the latter part of the year on the property of the Truro Company is shown by the very large yields milled in November and December which have swelled the total for this district over 1000 ozs. There is every reason to suppose that development of this property will largely increase Caribou's product for 1893. Stormont shows a gain of nearly 2000 ozs. over 1891, which is due entirely to the successful working of a large body of medium grade rock by the Antigonish Co.

In December the County Harbor Company cut the same lode in depth on their property, and as the latter company has now a 20 stamp-mill in running order the production of this district in '93 should be very much increased. The returns for 1892 are in the neighborhood of 2,700 ounces, of which the older portion of the district, Isaacs Harbor, contributes only 165 ounces. This small amount is due to the continued idleness of the Palgrave Company from long protracted litigation.

Malaga district shows a great decrease, amounting to over 2,000 ounces, having a total of about 2,600 ozs. as against 4,664 in 1891.

The total collapse of the Parker-Douglas Co. in January, 1891, and the low grade rock encountered in the last half of the year by the two other companies working there will account for the decrease. The yield for '93 is likely to show another decrease, as it is rumored that the Malaga Co. has closed down. It is a source of regret that this district should be the victim of mismanagement. The work of the last four years has proved the existence of some very rich veins, and of many others carrying pay ore, but it is doubtful if any other district in the province can show so many examples of bad management in recent times. Some day this district will pass into competent hands, when it will become a permanent and large factor in the annual production.

Montagu shows a total yield of about 2200 ozs., 1133 of which were won prior to the taking over of the properties in August by an English Company. This district may increase its product somewhat in 1893, and probably will do so, as a second mill has just been completed, and there should be at least three producing mines in the district for the year.

South Uniacke shows a large falling off compared with '91, due in part to the complete cessation of work by the Witherow-Putnam Co. and in part to the diminished output of the Thompson-Quirk Co.

The prospects for the next year are rather for a decrease than an increase, as the Thompson-Quirk Co. are getting into deeper and wetter workings and the pay chute is fast approaching the boundary line of the property. No new shaft in adjacent property can be sunk to pay rock and become a producing shaft to any extent within the year. The older portion of the district (Mount Uniacke) does not show any signs of vigorous life.

One of the large gains of the year is shown in the Waverley district, producing over 1000 ounces, and is due entirely to the work carried on there by the West Waverley Gold Co., Ltd., whose mill has only been in operation the last eight months of the year. It is to be regretted that the ore of this company proves so low in grade as to leave little or no margin for profit. Should the Company continue in operation throughout '93 the yield will be somewhat increased. The vigorous working of the East Waverley Tunnel Company may also add to the total of the district. The extensive works of the Lake View Company have remained closed down during the past year.

Perhaps the most notable decrease has been that of the once famous Salmon River or Dufferin mine, whose yield for 1892 is less than 1000 ozs. The most notable part of the decrease is in the small tonnage crushed; with a new modern mill capable of handling over 12,000 tons per year, the amount actually milled is about 3,700 tons. Recent examinations have shown this lode to be as large as ever, so that the decreased tonnage must be due to some policy of the management.

Sherbrooke still lies idle, its product for the year being about 150 ozs. This district has been unfortunate in having its territory cut up into small areas held by people who have neither the capital, skill nor willingness to work them, and who have asked ten prices for their property whenever a possible purchaser appeared. From information received at the close of the year it would appear as if this unfortunate condition of affairs was in a way to be remedied, the consolidation of two of these small blocks having been effected by a gentleman controlling both skill and capital, and possessed of a willingness to exploit the properties.

Owners of small holdings should always bear in mind that capital requires a sufficiently large aggregation of property to induce it to come forward and spend the large sums which have to be spent before low grade propositions (which Sherbrooke is) can be put on a self-sustaining (to say nothing of a dividend-paying) basis.

From the western districts there was very little production in 1892. Gold River, Whitham, Brookfield, Carleton and Kemptville are practically idle and non-producers. Large sums of money, in the aggregate, have gone into these districts, but have failed to produce paying mines. Reasons for this are not easy to give: in some cases the companies formed were badly financed, and promising lodes remain in a condition of partial development; in other cases it was the common story of mismanagement; and in still other cases the properties selected were worthless. No substantial revival of these districts is looked for in 1893.

Rawdon (both Central and East) continues idle, and Renfrew has suffered a total collapse. The mammoth mill at Gay's River has remained mute. Killag has had a complete new plant which was in operation in December, and this district is expected to be a prominent producer in 1893.

The past year as a whole has been one of remarkable quietness. There has been no boom nor any attempt at such with the single exception of the temporary excitement of a local paper over the sale of some properties to English

parties. The large producers have worked away steadily aed quietly, with a marked avoidance of any newspaper notoriety.

There is still a disposition amongst managing men to work out the surface streaks and to fail to provide, by means of proper development, for the inevitable rainy day. Moreover, although deep-mining has been talked about more or less for the past three or four years, there was only one mine in the Province in '92 that produced quartz from below 400 feet. The industry is yet far from occupying that position which it should (and will inevitably one day) occupy.

The yield for 1893, so far as can be foreseen, is not likely to run much ahead of 1892. There is always the chance of new discoveries being found and rapidly opened up, but this chance grows smaller each year, and the main reliance must be placed upon the older and better managed properties.

Nova Scotia Mines in 1892.

The season of 1892 has proved a dull one in all branches of mining. Operations in the three principal coal producing districts were continued quietly. The usual amount of coal appears to have been shipped up the River St. Lawrence, but the local sales and railway supplies were unusually dull owing to the mildness of last winter. The demand in Prince Edward Island was light, and the destruction by fire of the city of St. Johns, Newfoundland, lessened the usual demand for coal from that island. At the closing of navigation the general opinion was that the sales of 1893 would show a gratifying progress.

There have been no developments of interest in the coal fields of Cape Breton this year. The Emery and Gardener mines have settled down to a good working basis and produce an excellent grade of coal. Nothing has been done at the Ontario Mine since its acquisition in the spring time by some United States capitalists. Some prospecting was done, but the results of importance were the testing of the two seams, each five feet thick, reported as underlying the entire Glace Bay district. If the seams maintain their thickness they will prove very valuable. The operations of a party of Boston capitalists who have secured options on all the working collieries in the Sydney coal field, with the exception of part of the holdings of the General Mining Association, have aroused much interest. The coal operators in this district have for thirty years pursued an undeviating policy of cutting one another's throats, until one wonders there is anything left of them. Each colliery has maintained its own machine shop, railway, agent, manager, etc., although common sense would have dictated consolidation in many points of common interest, if not in all.

Should the new syndicate succeed in acquiring these mines and working them under a common management, their economies will make unpleasant uphill work for the Victoria and Sydney Collieries in competing with them as pits are deeper in the case of the Sydney Mines, and the coal steeper in the case of the Victoria mines. But it is to be presumed the average consumer will welcome competition: the more the merrier for him when he buys his coal.

It is understood that the large hulks employed by the General Mining Association, in the transport of coal by towage to Halifax have proved fairly remuncrative; the barges of the Glace Bay Company do not appear to be of large enough capacity.

In Pictou County the Intercolonial Colliery took a new lease of life. A large contract was secured in Quebec and during a part of the season the mine was worked on double shift. An underlying seam said to be of good quality was also developed. Operations by the Acadia Colliery were not as brisk as usual. Late in the fall fire was discovercd in the old workings of the Foord Pit in the main seam, and the shafts had to be closed, and the works were partially flooded. The opening of the blast furnace at Ferrona has assisted the mines in this district to get rid of their slack coal.

In the Cumberland County district an extensive underground haulage system calling for twenty-five miles of steel rope has been set up at Springhill, and has done away with a large number of horses. Other improvements have been made at the mines lessening the number of locomotives, concentrating the surface work, screening, etc. A company known as the Canada Coal and Railway Company, and backed by United States capital, purchased the Joggins Railway and Colliery and a number of coal areas between the Joggins and Maccan, and proposes to do a large business.

The total output, so far as returns are available, amounts to in round numbers 2,000,000 tons.

The Springhill Company has given contracts for three barges of one thousand tons capacity each and for a powerful steam tug to carry coal from Parrsboro to St. John, Portland, etc.

Manganese mining continued dull. A local syndicate purchased the well known Stephens Tenny Cape mine, and a few tons were mined from it and from the Moseley Mine, Cape Breton Co., amounting in all to about 100 tons of ore.

The production of plaster was about the same as in 1891. The Messrs. McCurdy, of Baddock, opened a new quarry at Port Bevis, and Col. Snow continued the development of his quarries at Mabou. As usual the bulk of the business was done in the Windsor district, and the quarries were worked steadily. There is a gradual increase in the local consumption of plaster for building purposes, and for fertilisers. The output was in the vicinity of 175,000 tons. The cessation of work on the Chignecto Ship Railway, and the suspension of all railway operations, diminished the output of the stone quarries of Cumberland and Colchester counties.

There has, however, been some progress made in iron mining and smelting. Work continued much as usual at Londonderry. This season, however, they have smelted large quantities of ore supplied by the Torbrook Iron Company from a mine at Middleton in Annapolis County. The ore is a red hematite of good quality, and said to be abundant. The New Glasgow Iron Coal & Railway Company during the past season completed their railway from Hopewell to Bridgeville, and in the fall got their furnace situated at the forks of the East River into blast. The product of the furnace is of good quality and finds a ready market. The Pictou Charcoal Iron Company, taking advantage of the branch railway to Bridgeville, has located an excellent furnace, foundry, etc., at that point, and having acquired large tracts of timber land has commenced the manufacture of charcoal pig from the excellent limonites of that locality. The output of these furnaces commenced too late in the season to show much increase in the year's production of iron, but next year will, it is hoped, show a respectable figure. For the past year it is estimated at 35,000 tons.

EN PASSANT.

3,000 lbs. of actinolite were shipped during the year from Bellevillc district.

Completed Consular returns of the exports of mica to the United States, from the Kingston district for 1892, show a value of $10,249.30.

During the year 1892 the shipments of nickel ore and matte from the Sudbury mines to the United States, as reported by the American Consul at Prescott, amounted to 3,325,714 lbs. valued at $203,748.23.

Every Canadian mine owner and operator who can afford the time should make a point of being in Montreal during the session of the International Mining Convention. The proceedings will open with a Reception given at Windsor Hall, at which a number of prominent statesmen will take part, and will last during the remainder of the week. The attendance promises to be large. Visiting mining men may be assured of an interesting meeting and an enjoyable time.

Mining machinery to the value of $61,848 was imported into Canada free of duty during the fiscal year ended 30th June, 1892. Of this $4,630 came from Great Britain and $57,218 from the United States. By provinces the imports were :—

Ontario	$25,824
Quebec	12,096
Nova Scotia	13,784
New Brunswick	2,030
Manitoba	6,364
British Columbia	1,750

On Wednesday 11th inst., a deputation from the General Mining Association of the Province of Quebec, had an interview with the Hon. J. S. Hall, Provincial Treasurer, anent the repeal of the Powder License as applied to mines. The deputation was given a good hearing, and we understand that while remedial measures cannot be expected this year, the Government is favorably disposed to reduce the amount to a reasonable basis.

Mr. J. Lainson Wills, F.C.S., late manager to the General Phosphate Corporation, has gone to England to take a hand in the adjourned meeting of the Corporation. Mr. Geo. Stewart, one of the vendors, will leave for the same purpose in a day or two.

The marvelously rich deposits of wealth explored and developed in the Cariboo gold fields, British Columbia, are at present attracting the notice of mining men from the State of Washington, who are seeking safe and profitable investments for their capital. The quartz excitement for the past three years throughout the State of Washington and the Northwest, has kept investors in mining properties at a fever heat during that time; but a reaction is evidently taking place in favor of placer mining, for now there seems to be unusual activity around placer mining circles, and Cariboo, is spoken of as the favored centre of attraction, where the discoveries of gold in the valleys and small streams that traverses them, would appear almost like tales from fairyland were they not attested by thousands of miners and the cold unvarnished fact that $60,000,000 worth of nuggets and dust has been produced from these sources. The bed of every gulch or creek in the district that has been worked has paid the enormous sum of $50.00 to $1,000.00 to the square foot of ground, and it is the general belief, based on well known facts, that there are immense deposits of gold in the deep channels that have never been explored. Like California and Australia, the deep diggings in Cariboo were beyond the limited means of the average miner. Thus, the richest placers have remained for the advent of capital to take hold and develop them.

By consulting the reports of the Department of Mines and the Geological Survey of Canada, it will be seen that there are immense possibilities for the investment of capital in this famous gold field. Gold abounds in every valley, and in every stream that empties into it. Should there be any doubt in the mind of the reader as to the richness of this Eldorado, a reference to the REVIEW of May, 1891, will set them at rest. In that issue it was pointed out that 202 pounds of gold was taken out by two men in one day. Thirteen hundred and forty feet of ground paid $1,510,000, and one pan of dirt yielded 387 ounces= $6,579. These figures are given for the purpose of showing the operatious of the past, when little capital and machinery were employed, which necessarily confined explorations to the deposits that lay near the surface.

In view of these facts and a grant of three miles of ground from the Provincial Government of British Columbia, a company has been organized at Tacoma, Wash., with a capital of $500,000, for the purpose of developing one of the principal streams in the gold basin of this district. The names and standing of the gentlemen who compose the Slough Creek Mining Company whose Prospectus is published in our advertising columns this month is a guarantee that they will perform the obligations of their lease, which requires an outlay of $5,000 annually for a term of fifteen years. The company commenced operations last June with a Chapman hydraulic jetting machine, and bored four shafts, locating the channel at a depth of 245 feet. The prospects encouraged the trustees in opening up a working shaft, which has been sunk 32 feet at this date. In connection therewith a drain tunnel is being constructed that will tap pay gravel at 40 feet below the surface. The drain when completed will be over 1,600 feet long. The capital stock of the company is divided into 500,000 shares at a par value of $1.00 each. The stock is now being sold at 50 cents per share. The money derived from the sale of stock is to be applied exclusively in opening up the property.

We very much regret that through an oversight a letter from a Sudbury correspondent reflecting upon the *personal character* of Mr. R. H. Ahn, should have found its way into print in our October issue. It is neither the province nor the policy of the REVIEW to indulge in personalties of this kind. We therefore withdraw the imputation conveyed in A. M.'s letter and apologise for its publication.

The consumption of coal upon the ocean amounts to a far greater tonnage yearly than is generally recognized. A Cunarder spends about $25,000 for coal per round voyage. But this is exceeded greatly by the ships making trips from Great Britain or United States to Australia. They will use nearly 8,000 tons of coal on the voyage out and in. These ships have, as a rule, some three coaling stations and can carry 2,700 tons in their bunkers. Hence it is apparent that the item for fuel in connection with steamers is about the most important. This is dependent upon the fact that speed is the great desideratum, and much as this has been the case in the past, it will be still more so in the future. In the competition of the day the quickest line of steamers will be the most economical and the ones that will be the most patronized. For hundreds of years the world was satisfied with the use upon the seas of the same force that speeded on the caravels of Columbus, but times have changed, and wind and wave are now subservient to coal. It may be fairly computed that at the end of the century, say in 1900, the coal tonnage of ocean consumption will amount to close in the neighborhood of 50,000,000 or 60,000,000 tons.

The second largest diamond in the world is now undergoing the cutting process at Antwerp. Its weight is at present 474 carats, but it will lose no less than 274 carats before it is ready for the market. Even then, however, it will be the second largest diamond in the world. standing between the 280 carats of the Persian diamond "Great Mogul," whose existence is considered very mythical to-day, and is said to weigh 193 carats, and the "Victoria," or "Imperial," diamond, the property of the Nizam of Hyderabad, and the Russian "Orloff" brilliant. The "De Beers Yellow" weighs 225 carats, recently sold to an Indian rajah. Roughly speaking, the Antwerp stone will be about the size of a pigeon's egg. In its present state it measures 2·741 in. by 1·767 in. Its polished surface will measure ·786 in. each way.

A trial is about to be made in Glasgow with vitrified bricks in the place of the stone and wood hitherto used for street paving purposes. Brick paving is common in some continental towns, but the difficulty of procuring the right kind of material for the manufacture of bricks in Scotland of a sufficient hardness and toughness has prevented that form of paving being tried for street purposes. Proper material has, it is said, now been found on the estate of Lee, near Braidwood, and the bricks are to be manufactured by the Omoa Fire Clay Company, which is erecting new works for the purpose. Whilst the material is called a clay, it is in reality a kind of hematite ore, and requires to be quarried. It is stated that the brick blocks are durable, clean, healthful, easy to repair, and comparatively noiseless, and that they are considerably cheaper than either granite or wood paving.

In a lecture delivered in England the other day Mr. Thomas Turner dwelt upon the waste products of iron manufactures. Economy in the matter of smelting might be said to have originated with Neilson in 1829, and since then there had been further developments and improvements by Bessemer, Siemens, Whitwell, Cowper and others, the great aim being to get the highest possible results with the minimum expenditure of fuel. He explained the various methods of utilising waste gases, stating that at Robert Heath's furnaces in North Staffordshire, and also at some of the works in Scotland, tar was extracted from the gas when it was hot, and ammonia when it was being scrubbed, and what remained served to fire the boiler. The furnaceman, therefore, instead of being the enemy of the agriculturist, as formerly, interfered but slightly with the purity of the air, and supplied valuable manures, disinfectants, &c. Basic slags were also now being used for road metal in this district, and in the north bricks, cement, &c., were made of it. Large quantities were also being used in the work of reclaiming land from the sea. Besides this, a process had been discovered for the production of slag wool, a valuable article for packing purposes, although its manufacture was not very remunerative as yet. Tap cinder was now found to produce a cast iron not of special purity, but suitable for many purposes, and the hot air from the puddling furnaces was frequently used to fire a boiler instead of being wasted as formerly. In the Bessemer process phosphate of lime was extracted, and found to be a valuable recuperative manure when applied to the ground, and a valuable substitute for bone manure in the products of wheat and other bone-producing foods.

News comes from the "freest country on God's earth" of an unwarrantable infringement of the liberty of the subject. Hitherto the ingenuity of claim-holders in fixing up distinc

tive and striking titles for their mines has been allowed the fullest scope and has been exercised without limit, but now a sort of censorship in regard to the titles of mines has been set up by the United States Land Office. The swearing, cursing and blaspheming miners are to have their wings clipped, and are to be deprived of the privilege of flaunting their disregard of sacred things in the faces of the public by means of the names they apply to their holdings. The Land Office has for instance refused to grant a patent to mining claims bearing the names of "Holy Moses" and "Jumping Jesus," and some of the mining journals have followed up their expressions of mock admiration of this sudden outburst of pious feeling by jumping very heavily on the chests of the Land Department, which is said to have winked at more frauds and been *particeps criminis* in more steals than any other department of the Government. It is wrong, very wrong, to interfere thus with the playful humor of the unsophisticated miner, and we sympathize heartily with our American friends whose wealth of resource in mine nomenclature has been ruthlessly curtailed by narrow minded State officials.—*Australian Mining Standard.*

In the annual report on the condition of British Guiana for 1891, forwarded by the Governor to the Colonial Office, there are some details with reference to the gold industry of the colony, which is a development of the last six or seven years. The report states that up to the present placer mining has been the only work, and this month by month draws increased expeditions to the goldfields. Ten years ago the output of gold amounted to £187, the following year the returns was *nil.* In 1885, washings produced £3,249; in 1886—and this may be accepted as the first year when the gold industry in reality commenced—the return was £23,342; in 1887, £44,427; in 1888, £55,566; in 1889, £109,234; in 1890, £234,324; and in the year under report, £375,289. Such strides as these cannot fail to have their attendant consequences. As everywhere else, embarkation in this industry is not without its speculative attractions, and in this respect an incident is narrated in the report. A year or two ago a prospector returned to town from the goldfields, having, as he stated, found a paying place. Not being in possession of sufficient ready money to work his find, he borrowed, or rather, had advanced to him by two gentlemen in town, the sum of £50, on the understanding that they were each to receive a third share in the undertaking. Thus set up, the prospector returned to his placer, working, to commence with, only a "torn"; before long gold by the hundredweight was the yield, and to-day the fortunate trio each enjoy an income of not less than £10,000 a year. This is not the only rich find, some of the other placers giving a return of 1,000 oz. a month. Quartz mining in all probability will, the report says, before long be started on an extensive scale in the colony. Specimens of quartz of a friable nature picked up on placer claims in the northwestern district have been tested by the Commissioner of Mines, and found to give a result of 56 oz. to the ton, whilst from another district of the colony a sample of between 500 lb. and 600 lb. weight gave a return of 152 oz. of gold to the ton. It is a common thing in working the placers to find auriferous quartz containing visible gold, but as yet the local gold-seeker is content to work his placer, leaving quartz mining to the future. There are about 700 laborers employed in the goldfields of the colony, with an average wage of 2s. 8d. a man per working day.

The following little story is related in the *Engineering Magazine.* Comment would be superfluous:—"A real-estate lawyer and a mechanical engineer both do business in New York city, and they are neighbors and acquaintances in the country. The lawyer not long ago had made a blue-print frame to copy maps and other tracings that come into his temporary possession. He had difficulty in getting clear lines, and on the train one morning he stated his trouble to the engineer, who explained the necessity of a close contact of the tracing to the sensitised paper over the whole surface. Presuming on this assistance, the engineer a month afterward asked the lawyer a legal question relating to a leasehold. The legal man could not answer on board the train and invited the engineer to his office, where the desired information was given in 10 minutes. On the first of the next month the lawyer sent in his bill for the advice. Then the engineer sent in a bill for a similar sum for his advice. The lawyer says it is "ridiculous—friendly talk on the train—don't remember much about it, but never heard of a bill for a little simple thing of that kind." Now why is it ridiculous for a mechanic to charge reasonably for professional advice?"

The Advantages of a Technical Education.*

By Charles Rodenberg,
Division Superintendent Consolidated Coal Co. of St. Louis.

Horace Greeley, while at the height of his fame and influence as a journalist, is said to have made use of the expression: "Of all horned cattle, deliver me from a college graduate."

This is preeminently a practical age. The sentiment so picturesquely expressed by the great editor is, to some extent, still dominant. The theorist, the scientist, the scholar, have often been compelled to make room for the practical man. Especially has this been true in the occupation of mining where we so frequently find men, who, in early life, were denied the privileges of an education, occupying positions of trust and responsibility and satisfactorily meeting the requirements of their positions. These men are certainly entitled to credit for their advancement, based as it is in the greater number of cases on demonstrated merit and ability. While no one could possibly entertain greater respect and admiration than I for the men, who, through their own exertions, often alone and unaided, have reached places of honor and distinction; yet, in these enlightened times, when the means of an education are so easily accessible, I believe that ignorance may justly be regarded as a crime, and that knowledge gained merely from experience is no longer sufficient.

I am supported in this position by the change in sentiment that is gradually taking place. The necessity for a technical education, of better mental training, is being felt more and more. The handwriting on the wall has made its appearance. A revolution has taken place in the industrial world. Conditions are constantly changing. Methods that were in vogue twenty-five years ago no longer exist. Inventions and discoveries have worked miracles. The possibilities of steam and electricity have not yet been fathomed. We must adapt ourselves to our changed surroundings and keep abreast of the times if we expect to hold our own in the struggle for existence. Competition in every branch of industry is stronger, sharper, and more active than ever before. Especially is this the case in the industry in which we are interested. Only, that man who has the ability, tact, and education required to recognize, appropriate, and employ the best and most advanced methods of mining, will prove successful. The legislature appreciated this fact, hence the law requiring a higher standard of efficiency on the part of our mine-managers. The gentlemen who were instrumental in organizing this Mining Institute, which gives us an opportunity for the calm and intelligent interchange of opinions, also recognized this necessity.

The cost of books has in recent years been greatly reduced. The works of the ablest authors of the present and past, men who have made the consideration of the problems which confront us in mines, their life work, can now be purchased for almost nothing. A very respectable library can be had for fifty dollars. Weekly and monthly periodicals, ably edited by men of splendid scientific attainments, reflecting the best thought of the day and devoted exclusively to a discussion of mining questions, can be had at very reasonable figures. Connection with an Institute organized for such purposes as this one is, will not fail to widen a member's mental horizon. With such means at our command is there any plausible excuse why we, who are engaged in mining should not have a better technical education? Is there any excuse for the ignorance of the mine boss of thirty years experience who, when asked at one of the late examinations what he knew about carbureted hydrogen, said he had never heard of such a machine! In fact, gentlemen, some of us are about as familar with technical terms as was the young man who enrolled himself as a student at a college which had a theological department connected with it. When approached by the examiner and asked what course of study he intended to pursue, the young man feebly shook his head and said he did not know. The examiner, wishing to assist him to arrive at a conclusion, asked him if he wanted to take the classical course. The would-be student again shook his head and answered: "No." "Do you wish to take the scientific course?" Another shake of his head and the same reply as before. "Do you want to take the theological course?"

* (Transactions Illinois Mining Institute.)

ASBESTOS EXPORTS FROM CANADIAN MINES.

Compiled from Official Returns for the Fiscal Year Ended 30th June, 1892.

Grade.	Great Britain.		France.		United States.		Germany.		Grand Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
	—	—	—	—	—	—	—	—	—	—
No. I....	581	$ 67,450	40	$ 8,039	1,777	$116,005	Nil	Nil	2,398	$191,494
No. II....	316	36,431	156	14,225	3,771	241,942	Nil	Nil	4,243	292,598
No. III....	59	3,108	6	283	398	18,009	212	8,920	675	30,320
	856	$106,989	202	$22,547	5,946	$375,956	212	8,920	7,316	$514,412

Note.—Of the above, Ontario exported 77 tons of No. I. valued at $3,115, the remainder being exported from Quebec mines.

Another shake. "Perhaps you want to enter the business course?" "No." Well, said the examiner a trifle vexed, "What course do you want to take up?" "I want to be a preacher!" was the answer.

Our experience teaches us that the inhalation of black-damp proves injurious to life, but we know practically nothing of the gases that enter into its composition. We know that fire-damp is explosive, but we don't consider it worth the trouble to ascertain under what circumstances, nor when it attains its greater explosive force. We, who so frequently come in contact with gases, breathe atmospheric air in blissful ignorance of the fact that it is composed principally of oxygen and nitrogen. Our knowledge of this most interesting branch of the science is confined to our ability to detect the gas when present and to remove it. Even this we are unable to do, unless we have witnessed the same thing done repeatedly. Practice eaables us to drive entries and lay off rooms at certain angles and at given distances with almost mathematical exactness and without so much as a speaking acquaintance with sines and cosines. If asked "why" and "wherefore" we are completely at sea, and are obliged to give a woman's reason: "Because." To what is our ignorance attributable, and how can we become more proficient? Our lack of technical education is directly responsible for the condition in which we find ourselves, and tbis can only be overcome by adopting as our motto the dying words of the immortal Goethe: "More light."

I have already intimated that it is not necessary to take a collegiate course in order to secure a technical education. The world is full of self-educated men, prominent in all the affairs of life, who are abundantly able to cope with the brightest graduates at Yale and Harvard. We should take advantage of the opportunities with which we are surrounded; employ spare moments in study and mental improvement. Abraham Lincoln never attended college. Andrew Johnson was taught to read and write by his wife. The elder Atkinson rose from the humbler walks of life Some of the distinguished gentlemen whom I have the honor of addressing and who are recognized throughout the state as among our ablest mining men, were never matriculated at college. Industry, energy. and perseverance remove all obstacles and overcome all difficulties. This Institute is a step in the right direction. It is the dawn of a brighter future. It will awaken a general interest in study and create a desire for greater proficiency. We should therefore contribute all in our power to make it a success. This can only be done by attending the meetings and conscientiously performing the duties assigned to us by the committee on programme.

Schools of instruction, membership in which costs but little, have been organized by the publishers of some of our more enterprising journals, and the experiment has proved highly satisfactory. The magnificent showing made in the examinations by the miners and mine managers who became pupils of The Colliery Engineer School of Mines is deserving of especial mention. It is a splendid demonstration of what close application and systematic study will accomplish. But the ulterior object of the technical education, of whose importance and necessity I am speaking, is not mere success at examinations. The possession of a certificate is not an evidence of superior ability. I regard the certificate only as a license to begin the study of the science of mining. The man who does not continue his studies, but whose ambition is entirely satisfied as soon as he has received his certificate, is deserving of profound pity. Indeed, it is a question whether the law should not require mine managers to be examined periodically, as the mine inspectors are. If the law should require this, would it not have the effect of making us cultivate a more intimate acquaintance with our books and periodicals?

A technical education carries innumerable advantages with it. The educated mine man is brought in contact with the master minds of civilization. The scholarly words of Wardle, Wilson, Atkinson, Fairley, and the host of other great authorities are open to him. He reads and comprehends. They are a source of profitable instruction to him. He can appropriate their ideas and employ the knowledge they have gained in years of study and experience for his own purposes. His education enables him to discriminate between good and bad methods, and to make a proper application of the former. He is prepared for every emergency and adapts himself quickly to changes in the system of mining. The educated mine manager doesn't require years of practical experience to understand the difference between hand and machine mining. He is thoroughly familiar with the new system long before the change is made. He is not helpless when placed in charge of a Longwall mine, although his previous experience has been confined to the pillar-and-room system. Scientific knowledge enables a man to apply his practical knowledge with less difficulty and more advantageously.

The educated mine manager is not in the habit of indulging in costly experiments that have been tried years before and an account of whose failure is to be found in any standard work on mining. It was lack of technical education that worked a hardship on a gentleman, whom, for convenience sake, we will call John Smith. John had been suffering for some time with a sore throat. He called on a doctor who gave him a hasty examination, wrote out a prescription, told him to use the medicine as a gargle and charged him one dollar for it. John had the prescription filled at a drug store and very cheerfully paid the two dollars demanded by the druggist. The gargle effected a cure. About a month afterwards John was again bothered with a sore throat. Remembering how much he was benefited on the former occasion, he hunted up the old prescription and started for the drug store with it. He noticed that the prescription called for aqua pura and chloride sodium. When the prescription was filled and John asked how much it cost, imagine his surprise when the druggist replied: "Oh, we don't charge anything for filling a bottle with water and salt the second time!" John concluded then and there that education pays.

Education broadens our views, removes prejudice, and causes us to entertain the views of others. It makes us more tolerant of the opinions of others. We no longer consider our methods the only ones worthy of adoption. It keeps us out of the ruts and makes us desirous of being benefited by the experience and teachings of others. It affords great protection to life and limb, reduces the number of accidents of all kinds, and renders property more secure. It produces greater skill and skill leads to economy. It stimulates to greater mental activity and brings about constant improvement. It leads to investigation and discovery. It revofutionizes men and methods. It accomplishes unlooked for results. It makes mining easier, safer, and more profitable. In the words of the poet Spencer:

> "Through knowledge we behold the world's creation,
> How in this cradle first he fostered was;
> And judge of nature's cunning operation,
> How things she formed of a formless mass.
> By knowledge we do learn ourselves to know
> And what to man and what to God we owe."

New Gold Extracting Process at Mount Morgan.

[Australian Mining Standard.]

The cheap extraction of gold from the Mount Morgan ore has been an absorbing problem with all those engaged in that branch of science. The old battery system (writes the Rockhampton *Bulletin*) failed to get within 30 or 40 per cent of the gold. The chlorination process overcame this difficulty, but at great cost; and the aim has ever been to secure the same results at a much lower charge. The attempts made have been very numerous, the directors affording full opportunities of trial to all who had a feasible system to offer. The latest has been the Bohm patent, which is the property of the Refractory Ores Reduction Company, Limited, London.

The plant shows first an iron cylinder lined to suit chemical solutions which it is intended to pass through it. In some cases, especially where the ore to be treated is very difficult of filtration, a filter of peculiar construction is arranged at either end. The dimensions of the cylinder between filters are –diameter 5ft, length 12ft. The cylinder is supported on standards, so that it can be turned on trunnions attached to its centre by means of a worm wheel and gear. Covers attached to either ends by means of bolts contain the closely grooved, perforated filter board, over which a fine woven cloth is stretched and secured to its outer edge. To introduce the powdered ore the topmost cover is raised by a running screw gear, and run on one side. The ore is then allowed to drop out, and at the same time the solvent solution is forced upwards by means of a small pump. By the time that the vessel is fully charged with ore the solution will be almost on a level with the top. The cover is then bolted down, and a continuous flow of the solution maintained by the pump (the overflowing solution being taken up by the suction and returned to the vessel) until all the gold and silver are in solution. Should the top filter tend to clog during the operation by the accretion of fine slimes washed out of the ore, an ingenious device of a hollow trunnion, and simply but cunningly contrived pipes, permits of the reversing of the vessel, without stopping the flow of solution, so that the upper filter becomes the lowermost, and is perfectly cleansed by the flow of solution in the opposite direction. In order to concentrate the volume of solution to be dealt with subsequently, provision is made for driving the rich solution out of the vat to the precipitators by means of air pressure, and the necessary additional wash water is passed through by similar means. The moment the ore is clean, which is discovered by means of a simple test, the top cover is raised, and a half turn given to the vat, when out tumbles the 10 or 15 tons it contained like a shot out of a shovel, and the vessel is righted to receive its next load.

A plant erected some time since by the Great Sheba Gold Mining Company in Africa, is dealing with very refractory ore at the rate of three charges per vat per day; giving a gross output for each vessel of 45 tons in the 24 hours, of an ore which could not be treated by the old percolation process under seven days, and even then 10 per cent less bullion was extracted. From this fact alone it is clamed the advantage of the invention may be gauged. Imagine, says Mr. Bohm, the hundreds of square feet of tank space required to accommodate 315 tons of ore, and compare it with the 20 square feet necessary for this rapid plant. The saving in buildings alone would constitute an enormous item; in fact their cost would be almost prohibitive for treatment on a large scale by the percolation process. Modified forms of this filter vessel, worked on the same principle of hydraulic leaching, are in operation, and are made to suit the mines and localities for which they are intended. Amongst others are a stationary vat, from which the tailings are washed by means of a high pressure water connection, and another having a hinged drop down bottom also with the object of rapidly disposing of the refuse matter. These vessels are being employed for the rapid treatment of ores by means of cyanide of potassium at Sheba, and Waihi in New Zealand. It may here be mentioned as a significant fact that the returns from this mine prior to the introduction of the plant, were only a little over £2,000 a month. On its erection they went up to £5,000, and have been fairly steady at that since. The principle is, however, adapted to any leaching process, and has been applied to an improved method of chlorination adopted by Mr. Bohm two or three years ago, with extraordinary results. He tells us that samples of the Mount Morgan ore, supplied to his testing works in London, were chlorinated and turned out in the short space of five hours, at a cost of only 3s. 9d. per ton of ore with an extraction of 98 per cent of gold.

The secret of the cheapness of the process lies in the fact that only sufficient chlorine to do the work is employed, and all the waste attaching to the use of a barrel process and its nauseating smells is avoided. While conducting operations in the well known Hungarian Government Works at Fernezeley, near Nagybanya, Mr. Bohm found that a solution of chlorine in water acted more rapidly and economically upon gold than the gas did, and after studying the various leaching processes at Capnikbanya and Chemnitz, he went over to London, and perfected and patented his process all over the world. It is his opinion, an opinion shared in by many scientific men in England, that the pressure necessarily generated in rapid leaching causes the solutions, chlorine or other, to act more readily on the ore, by keeping the surface of the metal free from saturated solution, and causing the solution to insinuate itself into any interstices that may exist in auriferous particles which may have been insufficiently fractured in crushing. Of course the gravitation of the ore acting against the upward flow of the solution causes a perfect separation of the mass, so that the best possible conditions for rapid work prevail. Included in the chlorination patent is a new precipitant for recovering gold from chlorine liquor (now being tested on the Mount Morgan solution) in a metallic state, which is working very successfully with a rapid chlorination plant in the east of Europe. This invention enables the gold to be taken from the precipitator in the form of a cement, the medium employed being attacked and dissolved by the solution as it rapidly passes through, to be recovered for re-use at a later stage. The saving of fuel, of loss by handling, and the immense gain by its cleanliness and efficiency for small bulk should recommend this precipitant to all users of chlorination processes.

On the Mount Morgan directors visiting the mine the other day, the new filter (12in square, and containing only 5in of precipitant) was passing as much solution as six large charcoal filters. Mr. Bohm, who returns shortly to New Zealand, where he is forming a company to take up some rich refractory mines for his process, has been at Mount Morgan for some time, arranging for the disposal of his plant, lately purchased by the Mount Morgan Company, which as stated has entered into an arrangement for the use of the process.

Mr. Bohm has lately purchased for his company the rights to a patented invention of the Chemist to the Russian Government which enables chlorine to be produced from a salt solution direct at one-fourth of the cost of any known method. The company have just received by cable an offer of £100,000 for the use of their process in one district of South Africa, which they have accepted under certain conditions.

Electricity and Compressed Air in Mining.

Mr. David J. Lloyd, manager of the Edinburgh (Ill.) Coal Company, read a very interesting paper on this topic before the last meeting of the Illinois Mining Institute. He has used both forces in driving mining machines and he is most decidedly in favor of the latter, from its efficiency, cheapness and its greater utility. The following are the concluding paragraphs of his paper on the subject:

"I want to say that our compressed air plant is giving the best of satisfaction, and I doubt whether electricity can be maintained with as little expense. Since installing our air plant we have used 9 rubber buffers at a cost of 75 cents each, 4 leather buffers at 62½ cents each, and have broken two extensions which cost $10 each. Our pipe line was laid upon the ground, excepting right at the receiver at the bottom of the pit, and we have never experienced any trouble from the breaking of the joints excepting at the receiver once, and at another time when the line passed over the track of a cross-entry overhead. I venture to say that the cost of laying the pipe will not in our case exceed the cost of hanging a wire. I will also say that taking pipe and wire of equal capacity for transmitting power the pipe will prove the cheaper. For it should be borne in mind that the transmission of electricity to coal cutters requires two wires, and not merely one, as in electric haulage; one to, and one from, the point where the power is applied. If the entries are in good condition and uniformly timbered, it is but a simple matter to fasten the brackets and suspend the wires; but with entries like ours and many others, where the top is irregular and the timber sometimes entirely omitted, it will be necessary to put up timber, or drill holes in the ribs expressly to carry the wires. Then when falls off the roof occur, if they do not break the wires, they will usually bring them to the floor, and frequently cut the insulation, and thus allow the current to be dissipated in the ground. With the compressed air pipes laid firmly on the ground, it is almost impossible to break or displace them, even by an extensive fall.

"Compressed air is not only perfectly harmless, but it is highly beneficial from a sanitary standpoint. You can operate compressed air machines in headings or cross-

cuts owing to the constant supply of fresh air derived from the exhaust, where it would be almost impossible to work by hand or with electric machines.

"In the presence of fire-damp electricity may become very dangerous, and it is the judgment of some authorities that there are mines in this state in which it would be impossible to operate electric haulage because of the flashing sparks on the wires and rails, and the certainty of igniting the gas which might accumulate near them.

"My main point, however, is that what the operator wants is power from a source which will give the highest degree of efficiency. So far as my observation and experience goes, this is not, as yet, electricity. That it may become so, I am quite prepared to admit; but at present, and for practical purposes, compressed air is the agency which in my judgment offers the best results, both in the matter of safety and economy."

Some New Nickel Minerals.

By Stephen H. Emmens, Youngwood, Pa.

I have of late had occasion to examine numerous samples of ores from the recently developed mining region known as the Sudbury District, in the Province of Ontario, Canada; and in the course of such examination I have met with three nickeliferous minerals that appear to be distinct from any species hitherto described.

FOLGERITE.

This is found in the Worthington Mine, on the Algoma branch of the Canadian Pacific railroad, about thirty miles southwest of Sudbury. The mineral deposit here opened up is of a character similar to that usually observed in the mines of the district; that is to say, it consists of a mixture of pyrrhotite and chalcopyrite, forming ore masses of approximately lenticular form and of varying magnitude, imbedded in a greenstone dyke traversing the Huronian rocks that constitute the chief geological features of the region.

The pyrrhotite is in itself nickeliferous to a greater or less degree in every mine of the district; but at the Worthington mine it is found to be associated with a distinct sulphide (Folgerite), carrying a very high percentage of nickel. This sulphide is spoken of by the local miners and newepapers as being millerite, but it differs widely from that species. Its chief characteristics are as follows:—

Lustre.—Metallic.

Colour.—Light bronze-yellow in mass, but almost tin-white when broken up into fine grains.

Specific gravity.—No determination of the pure mineral has been made, but a fragment associated with adhering pyrrhotite showed a specific gravity of 4.73.

Hardness.—3.5.

Streak.—Grayish-black.

Form.—Massive, with a platy structure. No crystals have as yet been observed.

Fracture.—Irregular. When comminuted the large fragments preserve a platy form, while the smaller particles are finely granular; very brittle.

Heat re-action.—When the powdered mineral is heated in a closed tube no sublimate is produced.

Solubility.—The mineral dissolves in nitric acid, with separation of sulphur and a green solution.

Magnetism.—In large fragments the mineral is non-magnetic. In minute grains it is magnetic. The finely-triturated powder is non-magnetic.

Microscopic appearance.—Under both lens and microscope the powdered mineral appears in the form of shining white grains of irregular form; very distinct from the shining spicules of a light brass-yellow colour which constitute the powder of true millerite.

Chemical analysis.—The specimens analysed were magnetically separated from the accompanying pyrrhotite and gave the following results—

	A	B	C
Nickel	35.20	31.45	29.78
Iron	33.70	31.01	26.89
Sulphur	31.10	37.54	43.33
	100.00	100.00	100.00

Specimen A consisted of platy fragments, each one of which was tested separately with the magnet. Specimens B and C were separated in the form of a coarse powder from the accompanying pyrrhotite and probably still contained some adhering particles of that mineral. In the cases of B and C the analysis was conducted by first roasting the mineral and then fusing with potassium bisulphate, followed by solution, peroxidation, precipitation of the iron and electrolytic separation of the nickel—all with the usual precautions. In the case of A the raw mineral was dissolved in aqua regia. The sulphur was estimated by difference, and a check determination (by fusion of the raw mineral with sodium carbonate and nitrate and final precipitation as barium sulphate), for sulphur only, in a fourth sample, gave 34 per cent. It may also be mentioned that specimen A came from the Worthington mine, and that B and C were sent to me with the statement that they came from a deposit at the north-east extremity of the Worthington greenstone dyke. This deposit is distant about one mile and a half from the Worthington mine, and has recently been explored by the Emmens Metal Company. But when Mr. C. T. Mixer, the chemist of that company, paid a visit of inspection to the workings, the person in charge who had sent me the specimens in question could not point out the place whence he had taken them, and could not show any further occurrence of the mineral *in situ*. It is probable, therefore, that A, B and C all came from the Worthington mine.

The formula corresponding with the above-mentioned analysis is Ni Fe S_2, which corresponds to

Nickel	32.87
Iron	31.30
Sulphur	35.83
	100.00

This composition is between Ni S (millerite), and Ni Fe_2 S_3 (Pentlandite.) It is also distinct from that of the "ferriferous polydymite" found at the Vermillion mine, a little to the north-east of the Emmens Company's working, and described by Clarke & Catlett (*American Journal of Science*, 1889, p. 372) as containing 43.18 per cent. of nickel, 15.47 per cent. of iron, and 41.35 per cent. of sulphur, and as approximating, therefore, to the formula Ni_3 Fe S_5.

I have named this mineral Folgerite after Commodore W. M. Folger, the Chief of the Bureau of Ordnance in the United States Navy Department, in recognition of that distinguished officer's achievements in the utilization of nickel steel.

BLUEITE.

This mineral has for some time past puzzled the Sudbury miners, who have locally dubbed it "Jack's tin." It is found in several mines of that district, and notably at the working of the Emmens Metal Company, where it is found associated with niccolite, gersdorffite, pyrrhotite and chalcopyrite, in the outcrop of a quartz vein cutting the before-mentioned greenstone dyke.

The following are the characteristics of the mineral:—

Lustre.—Metallic, somewhat silky.

Colour.—Pale olive-gray, inclining to bronze.

Specific gravity.—4.2.

Hardness.—3 to 3.5.

Streak.—Black.

Form.—Massive. No crystals have as yet been observed.

Fracture.—Sub-conchoidal, irregular; brittle.

Heat re-action.—When the powdered mineral is heated in a closed tube sublimate of sulphur is produced.

Solubility.—The mineral dissolves readily in nitric acid without separation of sulphur and yields a yellow solution,

Magnetism.—The mineral is non-magnetic.

Microscopic appearance.—Under the lens the powdered mineral appears to be composed of irregular grains of a dull gray colour. Under the microscope the colour appears a dull grayish black, and the particles are seen to be finely granular without any crystalline form.

Chemical analysis:—

Nickel	3.5
Iron	38.8
Sulphur (by difference)	52.3
Insoluble	5.4
	100.00

After deduction of the insoluble matter (gangue), the figures for the mineral become—

Nickel	3.70
Iron	41.01
Sulphur	55.29
	100.00

The sulphur is probably too high, as, owing to the character of the gangue, a portion of this latter may have entered into solution.

The formula Fe_{12} Ni S_{26} = (Fe Ni) S_2, where Fe Ni = 12 : 1, corresponds with the foregoing analysis, the figures of such formula being—

Nickel	3.76
Iron	42.96
Sulphur	53.28
	100.00

The considerable percentage of nickel (a very rare element in pyrite), and the easy solubility in nitric acid without separation of sulphur, seem to preclude this mineral from being considered merely as a nickeliferous variety of pyrite or marcasite. I have named it *Blueite* after Mr. Archibald Blue, late Secretary of the Royal Commission appointed to investigate the mineral resources of Ontario, and now Director of the Bureau of Mines of that Province.

WHARTONITE.

This mineral was brought to me by Mr. C. T. Mixer, from a mine situated about seven miles north-east of Sudbury, and about two miles from the Blezard mine, worked by the Dominion Mineral Company. It has been known locally as the Shepherd Mine, and is of a character similar to the general mines of the district.

The following are the characteristics of the mineral:—

Lustre.—Metallic.

Colour.—Bronze-yellow.

Streak.—Black.

Form.—Cellular; the cavities being lined with minute cubic crystals, and the intermediate substance being finely granular. This structure precludes the specific gravity and hardness from being determined with precision. A large piece showed a specific gravity of 3.73 and a hardness of 4.

Fracture.—Irregular; brittle.

Heat re-actions.—A sublimate of sulphur in a closed tube and fumes of SO_2 in an open tube. A sulphur flame is observed on heating a fragment held in forceps.

Solubility.—The mineral is soluble in H NO_3, with separation of sulphur and a greenish-yellow solution.

Magnetism.—On comminution about 10 per cent. of the mineral is found to be magnetic.

Microscopic appearance.—Under both lens and microscope the powdered mineral is seen to consist of grayish-black grains of irregular form and finely granular structure, with occasional minute cubic crystals.

Chemical analysis:—

Nickel	5.40
Iron	42.90
Sulphur	45.00
Insoluble	4.80
	98.10

After deduction of the gangue, these figeres give—

Nickel	5.79
Iron	45.98
Sulphur	48.23
	100.00

Separate determinations of iron and sulphur were made in the magnetic and non-magnetic constituents, respectively, with the following results:—

	Mag.	Non-Mag.	
Iron	66.55	40.4	+ A little gangue,
Sulphur	7.00	52.6	

and a qualitative examination showed that the nickel was clearly with the non-magnetic portion.

The inference deducible from these observations is that the mineral is a mixture of a nickel-iron-disulphide, with some magnetite; and taking the proportion of this latter as being 10 per cent., we have for the composition of the other constituent—

Nickel	6.27
Iron	41.44
Sulphur	52.29
	100.00

This corresponds to the formula: Fe_7 Ni S_{16}, or (Fe Ni) S_2, in which Fe : Ni = 7 : 1, and of which the figures are—

Nickel	6.10
Iron	40.68
Sulphur	53.22
	100.00

It may be that this non-magnetic mineral is in part composed of pyrite, in which case the formula will require modification. The aggregate, however, is distinguished by its form and nickeliferous character from pyrite and marcasite.

I have named this mineral *Whartonite* after Mr. Joseph Wharton, of Camden, N. J., in recognition of that gentleman's eminence as the head of the nickel industry in America.

NICKEL AND NICKEL-IRON SULPHIDES IN GENERAL.

For the purpose of indicating the relations of all the known nickel and nickel-iron sulphides to each other, the following table may be found useful:—

Name.	Percentage Constitution.			Molecular Constitution			
	Ni	Fe	S	Ni S	Ni S_2	Fe S	Fe S_2
Millerite	64.72	.....	35.28	1	..	..	
Polydymite	59.47	.....	40.53	3	1	..	
Beyrichite	57.90	.....	42.10	2	1	..	
Ferriferous Polydymite	44.92	14.26	40.82	3	..	..	1
Folgerite	32.87	31.30	35.83	1	..	1	
Pentlandite	22.03	41.95	36.02	1	..	2	
Horbachite	11.24	42.81	45.95	1	1	1	1
Inverarite	10.44	49.72	39.84	1	..	4	1
Whartonite	6.10	40.68	53.22	..	1	..	7
Blueite	3.76	42.96	53.28	..	1	..	12

It remains to be added that the analyses of the new minerals herein described were made by Mr. C. T. Mixer.

Incline Truck Drop for Calcining Kilns.

A new incline truck drop for use in connection with calcining kilns, is described by Mr. C. Wood in a paper read before the Cleveland Institute of Engineers. This drop was designed for lowering the trucks from the top of the kilns at the Tees ironworks, where the space was very limited, and for that reason a drop of the ordinary design was not admissible. After a description of the form of drop usually employed in the district, the details of the latter design are given. Four columns support girders, on which is mounted a shaft with four rope pulleys and a break-sheave. The counter-balance weights work inside the two main columns. These stand on one side of the centre line of the kilns, from which the truck is run on to the lowering table, its weight being so placed as to keep the guide wheels in position. The table at the bottom of its travel is tilted automatically, and the stops withdrawn so as to discharge the trucks on the same side as that on which they were received.

The Collieries of British North America.

The most important mineral—by values—produced in the Dominion of Canada during the year 1890 was coal, the quantity of which (3,117, 661 tons, valued at places of production at 6,496,110 dols). exceeded the production of the preceding year by 398,183 tons. As I have pointed out in an earlier contribution, almost all this coal was produced in the oceanic provinces of British Columbia and Nova Scotia, but the coal deposits of the North-West Territories are of enormous importance—nay, are apparently inexhaustible, the coal-bearing area being there estimated at 65,000 square miles, comprising seams of coal of varied thickness, estimated to produce 4,500,000 to 9,000,000 tons of lignite and bituminous coal per square mile. Inasmuch as the United States of America have hitherto controlled the production of anthracite coal, it is interesting to note that, in the proximate Rocky Mountains large quantities of anthracite have been discovered, and are now operated near Banff, on the line of the Canadian Pacific Railway, the Canadian Anthracite Coal Company and other concerns. All the coal consumed by the great transcontinental line from the town of Brandon west to the Pacific coast is now exclusively the produce of the native mines, and as a constant demand for anthracite is maintained at San Francisco, which is nearer to the Canadian mines than to the American points of production, I can hardly do otherwise than concede to the Banff mines a complete monopoly of the markets of California themselves. Furthermore, we must recognise the importance—from an imperial point of view—of large deposits of this smokeless coal within two days' journey of the principal naval stations of the North Pacific Ocean, and admit that this vast unexploited coal region of the North-West Territories is to be the field of lucrative enterprise in a near future. In considering these mines, and, in fact, all the mines of British America, I shall advance from Vancouver Island to Cape Breton, thus :—

BRITISH COLUMBIA.

In British Columbia, six coal mining companies, with an aggregate approximate authorised capital of $5,508,000 are now in operation, viz.:—

The Cambrian Coal Company, Limited, with an authorised capital of $83,100, divided into 831 £20 shares, and owns 831 acres of mineral land in the Cedar district of Vancouver Island, but the operations are either temporarily suspended or of little importance relatively.

The Crow's Nest Coal and Mineral Company, Limited, with an authorised capital of $2,000,000, divided into 20,000 shares of a par value of £20 each, owns 11,000 acres of coal lands near Martin Creek and Morrissey Creek, in the East Kootenay district, but although $30,000 have been expended up to October 1, 1890, in prospecting, &c., mining upon any extensive scale will not be initiated until more advantageous shipping facilities have been provided. The analysis of the seam is :—Hygroscopic water, 1·89; volatile combustible matter, 30·41; fixed carbon, 63·33; ash, 4·37; Coke per cent., 67·70.

The East Wellington Coal Company (Nanaimo Harbour) has a capital of $1,500,000, and operates the East Wellington Collieries, at Nanaimo, directed exclusively by San Francisco men, who in 1889 employed 190 men and produced 51,272 tons of coal, of which 7,636 tons were consumed at home, and 43,089 tons exported. The seam varies from 2½ feet to 7½ feet in height, into which five levels have been driven and two good shafts sunk, and is connected with the wharfs at Nanaimo by a railroad four and a-half miles long. Two pairs of hoisting engines lift the coal to the screens, whence it is despatched in 34½ ton cars, drawn by two locomotives to Nanaimo.

The New Vancouver Coal Mining and Land Company of London, which was formed to acquire the properties of the Vancouver Coal Mining and Land Company, owns some 32,000 acres of freehold land, and operates the Nanaimo collieries upon Vancouver Island, the total output of which for the year ending 31st December, 1890, was 389,500 tons, distributed as to home consumption 98,340 tons, and as to exportation 292,809 tons. Four principal shafts are in operation thus :—

	Seam. Ft. in.	Ft. in.
South Field, No. 2	5 0 to	10 0
" " 3	5 0 "	10 0
Esplanade " 1	5 0 "	12 0
North Field " 4	1 6	

From which railways diverge as to the South Field mines, five miles long with siding; as to the Esplanade mine, one mile; and as to the North Field mine, four and a-half miles to Departure Bay. The line is laid with steel rails 56 lb. per yard, gauged according to the standard, viz., 4 ft. 8½ in. The mines are equipped with eight hauling and pumping engines, twelve steam pumps, four locomotives, 200 6-ton coal cars, lumber, and ballast cars, fitting shops, lathes, boring, drilling planing, and screw-cutting machines, hydraulic presses, steam hammers, and diamond boring machines. Besides these facilities at the shipping port there are wharves of 1,070 feet frontage, at which ships of the largest size can load at all stages of the tide, at convenient localities with brick fields, stone quarries, &c. The net output from the East Field mine during the half-year ending June 30, 1891, was 75,226 tons. Electric haulage has here been introduced, installed by the Edison Electric Company, whose system is estimated to yield considerable savings in the cost of production. South Field No. 2 :—The net output during the same period was 100,180 tons. A new shaft has been sunk 505 feet into 6 feet of coal, which indicates 1 foot more coal then encountered furthur away in the old shaft.

The net output from the South Field No. 3 was 35,000 tons of pillar-drawn coal, that of South Slope Field No. 4 (a driven slope) 624 tons, and that of North Field mine 42,257 tons for the half-year to June, 30 1891. An analysis of the principal seams by slow coking indicated :—Volatile matter, 38·40; fixed carbon, 51·45; ash, 10·50; coke firm.

Union Colliery Company of British Columbia, Limited. As mentioned in a prior contribution, the coalfields of Vancouver Island cropping out at the north-west corner of the island, trend south-east and again enter the water at Nanaimo upon the south-east coast, being thus, like those of Cape Breton, in the form of a fringe of a coalfield the main body of which reposes upon the bed of the Straits of Georgia, this fringe being divided by a synclinal into the Nanaimo and Comox basins, in the first of which the collieries just described exist, and in the last of which the Union Mine is in operation producing 31,204 tons in 1889, distributed as to exportation 23,790, and as to home consumption 100 tons; and 69,537 tons in 1890, distributed as before, 74,048 tons and 1,481 tons respectively. The seam is of good coal, 7 feet 6 in. thick, indicating hygroscopic water 1·70, volatile combustible matter 27·17, fixed carbon 68·27, ash 2·86, and is operated by twelve miles of railway, 4 feet 8½ in. gauge, two locomotives, fifty coal wagons, one diamond drill, four stationery engines, four steam pumps, one wharf, &c.

These Vancouver coal mines in the aggregate yielded 1,029,097 of bituminous coals in 1891, of a very high quality, commanding a better price at San Francisco—where they rank with Northumberland West Hartley—than any other coal of America, and compare therewith as to steam properties thus :—Wellington 1·407, Nanaimo 1·335, Seattle, Washington Territory, U.S.A., 1·330.

Their total production from 1874 to 1890 (both inclusive) was :—

	Tons.		Tons.
1874	81,000	1883	213,000
1875	110,000	1884	394,070
1876	139,000	1885	365,000
1877	154,000	1886	326,636
1878	171,000	1887	413,360
1879	241,000	1888	548,017
1880	268,000	1889	649,409
1881	228,000	1890	759,517
1882	282,000		

Making a total of 5,343,009, or an average per annum of 314,294, being an average of 1,072,964 tons less than the average of Nova Scotia bituminous coals over the same period, the total production of which was 23,583,395, with an average of 1,387,258. The following were the exports :—

	Tons.		Tons.
1874	51,001	1883	271,214
1875	65,842	1884	245,478
1876	116,910	1885	250,191
1877	118,252	1886	274,466
1878	165,734	1887	356,657
1879	186,094	1888	405,071
1880	219,878	1889	470,683
1881	187,791	1890	508,882
1882	179,552		

Making a total of 4,073,696, or an average per annum of 239,629, being an average of 51,177 tons greater than that for Nova Scotia over a similar period, the exportations of which were 3,203,701 tons, or an average of 188,452.

The markets for British Columbian coal are very important, viz., the markets of the North Pacific coast of America, and the home markets in a country where miners are rapidly developing the superior wealth of the allied mineral.

NORTH-WEST TERRITORIES (INCLUDING MANITOBA).

In the North-West Territories of Canada six coal-mining companies, with an authorized capital of 4,125,000 dollars, are in operation, thus :—

Alberta Coal and Railway Company.—This company owns the Lethbridge Collieries, at Lethbridge, in the Province of Alberta, and there operates the Coal Banks seam, 5 ft. 4 in. thick, capacity 5,500,000 tons per square mile, of which the following are proximate and ultimate analyses :—

	Per cent.	
Proximate—		
Hygroscopic water	6·50	Lignite.
Volatile combustible matter	31·59	
Fixed carbon	54·36	
Ash	7·55	
Ultimate—		
Carbon	65·30	
Hydrogen	4·30	
Oxygen and Nitrogen	15·65	
Sulphur	0·70	
Ash	7·55	
Hygroscopic water	6·50	

These coals are similar to the class of fuels now largely mined and consumed on the western part of the line of the Union Pacific Railway, and are much superior to most of the lignites and brown coal which feed important industries in various parts of Europe. One hundred and seven miles of rail connect the shaft with the main line of the Canadian Pacific Railway, sixty-five miles of line with the international boundary, whence 133 miles of rail connect with the Great Falls in Montana State. The average amount of labour employed is about 400 persons. The production in short tons in 1890 was 129,000, and in 1891 143,000 tons. The estimated value of the colliery equipments is $1,000,000, and the seam is uniformly worked by the pillar-and-room method.

The Canada North-West Coal and Lumber Syndicate.—This company operates a 16 ft. seam of coal, dipping under 1,280 acres of the company's land at an angle of 45 deg., by means of a slope 270 ft. long, laid off as to a main heading 270 ft., east heading 1,500 ft., and west heading 700 ft. The system of ventilation is performed by a self-contained Guibal fan 6 ft. in diameter, 200 revolutions per minute; and the plant comprises multitubular boilers, Tolson's hoists in gear, of a capacity of 300 tons per day, Blake pumps 15-horse power, Ingersoll drills, two 20 ft. steel bar screens, and nut screen ½ in. mesh, pitched 35 deg., capacity 160 tons each. The average output on October 1, 1890, was 100 tons per day, principally consumed by the Canadian Pacific Railway. The quality of the mineral is determined by the following analysis: Fixed carbon, 86·80 per cent.: gas, 7·96; moisture, 2·06; ash, 3·16; and sulphur 0·02 per cent.

H. W. McNeill Company, Limited.—This company is an anthracite coal company, on the main line of the Canadian Pacific Railway Company in Alberta, operating a seam of anthracite coal 10 ft. thick by means of a slope 380 ft. long, and a main rolley-way 600 feet in length; seventy persons are employed, Clanny lamps, and fan ventilation used. The coal is won by pillar-and-room, and the output in 1891 was 4,000 tons. The mines, which are merely the pioneers in this region, shall aid in supplying with fuel the vast populations and the allied industries, which shall spread over the broad plains of the Canadian interland, and are even now surely, if steadily, pursuing a fairly even course of progress, as may be determined from the following figures, showing the output of coal in the North-west :—

	Tons.
1887	74,152
1888	115,124
1889	97,364
1890	128,953
Total	415,593

The markets are native, and exterior, such as the border states of the American Union.

NOVA SCOTIA.

In the Province of Nova Scotia, popularly termed "the coalhole of the new British nation, and the backbone of the West's creation," sixteen colliery companies hold properties under a total authorized capital of $12,700,000, approximately equivalent to £2,540,000 sterling, operated thus :—

Acadia Coal Company, Limited.—This company has an authorized capital of $4,000,000, unhampered by bonds or mortgage, and is undoubtedly one of the most important collieries of British America. The collieries are four in number, thus :—

Albion Mine.—The second railway built in America was built at this colliery, where, until recently, the famous locomotive "Samson," built in 1838, exhibited at Chicago Exhibition, and now sold to the World's Fair, remained. The shaft was sunk 900 ft. into the main seam, which is 38 ft. thick, and in which, inclusive of bank labour, 480 persons are employed, and at a depth of 1,048 ft. another seam is encountered 22 ft. thick, the analysis of both of which I give: 38 ft. seam, hygroscopic water 1·48, volatile combustible matter 24·28, fixed carbon 66·50, ash 7·74; 22 ft. seam, hygroscopic water 2·54, volatile combustible matter 20·46, fixed carbon 68·50, ash 8·50. The machinery is massive and includes—a hoisting engine, 38 in. cylinder, 5 ft. stroke, geared to an 18 ft. drum; Cornish pumps, 62 in. cylinder, 9 ft. stroke, 34 ft. beam, 7 ft. thick at the poise, weight 18 tons; 18 in. working barrel and steam revolving tippler; a Bricort movable screen from Drifton, Penn.; a 35 ft. belt for cleaning coal; shaking screens, steel pit head frames 50 ft. high, and compressors 36 in. cylinders, 6 in. stroke; ventilating fans, Mueseler lamps, and 125-coke ovens, beehive pattern, 10 ft. diameter.

Acadia Mine (3 miles distant).—This is a difficult mine to manage; the shaft has a perpendicular depth of 1,500 ft., and as the coal is tender and contains a large percentage of gas (32·17 per cent. of volatile combustible matter), the enormous pressure causes the gas to exude from roof and sides. No explosives are used, and the only lights in use are the Marsaut and the Mueseler lamps. Iron beams have been very successfully substituted for wood in the levels where the roof is bad, thus fully demonstrating the superiority of such as main hauling roads and airways at least. Concerning these, I have only one opinion, and that is, that they are superior. Seven years ago in this mine railroad rails were used to support a section of bad roof, and are at this hour as good and solid as ever; whereas, where the roof is good, the wooden beams have been renewed every two years. Bad roofs and firedamp were prominent features in this mine. The seam, 10 ft. thick, dipping 27 deg., is entered by a slope 3,600 ft., operating in lifts of 400 ft., with counter balance planes every 400 feet. Primary narrow bords are driven inbye, followed by pillar workings outbye from boundary, ventilated by a fan 24 ft. x 8 ft., iron cased, drained by duplex compound condensing pump 22 in. x 11 in. x 24 in., rams 5 ft. 5 in., 2,400 column, 990 ft. vertical head, metal-flanged, unleakable wrought piping, tarred for 6 in. at the upset ends, and 4 in. cased in infusorial earth from

" Correspondence to the Colliery Guardian.

a near-at-hand deposit, top steam pressure 105 lbs., and air feeder; an auxiliary duplex compound condensing engine 14 in. x 8 in. x 16 in. (at the shaft bottom, etc., equipped with a 32 in. cylindered hoisting engine, 60 in. stroke, acting directly on to a 14 ft. drum), 240 persons are employed at bank, and lighting is by Mueseler and Marsaut lamps.

Vale Colliery (six feet seam).—The longwall system has here been unsuccessfully introduced at a point 2,000 ft. from the entrance to the slope; the roof is of a very strong nature, and slips run into the face to an extent which renders it both troublesome and expensive to keep the working open. Pillar work, has, however, been more successfully carried on another portion of the pit, and the masters persevere. Considerable expense and loss has been incurred by several very heavy feeders of water. The seam, as I have related, is 6 ft. thick, the ingredients of which are, of hygroscopic water 2·22, volatile combustible matter 30·23, fixed carbon 59·70, ash (white) 7·85. The pit employs 240 persons, and is entered by a slope.

Cumberland Coal and Railway Company's Springhill Collieries.—Some 1,400 persons are employed in and about this colliery, which is situated in the Springhill coal fields, north of the Cobequid Mountains. The following is a section of the measures of this district: North seam, coal, 13 ft.; strata, 105 ft.; coal, 5 ft.; strata, 130 ft.; coal, 2 ft. 4 in.; strata, 185 ft. Main seam: 11 ft.; strata, 80 ft. South seam: 11 ft.; strata, 100 ft.; seam, 8 ft. 6 in.; strata, 190 ft.; seam, 4 ft.; strata, 176 ft.; seam, 2 ft. 9 in. The following is an analysis:—

	North Seam. Per cent.	Main. Per cent.	South Seam Per cent.
Moisture	1·625	·78	1·39
Volatile combustible matter	28·672	31·32	31·22
Fixed carbon	65,431	62·54	61·58
Ash	4·272	5·34	5·79
Sulphur	·783	1·38	·80
Evaporative power	8·99	....	8·46

From which we observe that the coal is suitable for domestic purposes, furnaces, locomotives, etc. The extent of country underlain by the productive measures has been estimated at 300 square miles. The district is intersected by the Intercolonial Railroad, whence a branch connects with the port of Parrsborough, where rather extensive docks have been constructed.

Intercolonial Railway Company, Limited.—This company, employing 350 persons, owns one and three-quarter square miles of coal land, under lease from the Nova Scotian Government, and operates the Drummond Colliery at Westville, County Pictou, where the seam is 11 ft. to 13 ft. high, of the following composition: Moisture, 1·52 per cent., volatile combustible matter (fast coking) 31.87, fixed carbon 57·78, volatile combustible matter (slow coking) 29·46, fixed carbon 60·19, ash 9·10, sulphur 1·62, theoretic evaporative power 8·24 per cent. It is wrought at a dip of 31 deg., by slopes 4,000 ft. long, divided into lifts per 500 ft., and a counter balance plane every 450 ft. to 500 ft., ventilated by a 20 ft. x 7 ft. exhaust fan, run at forty-five revolutions per minute, current 100,000 ft. per minute. There are twenty-five beehive coke ovens. The main levels are watered, a plan which relieves the horses and depreciates the liabilities of fire, and an economical feature in underground haulage is a tail rope running with twenty-two tubs per trip, under which circumstances one boy is able to do the work of eight horses and eight drivers.

Canada Coal Company (Joggins Mine).—This company leases three square miles of coal land and operates the Joggins Mine, near Maccan, Cumberland, where the seam is 6 ft. to 8½ ft. thick, 4 ft. to 5½ ft. of which is wrought longwall by 220 persons. (The seam has a clay band 1 ft. to 3 ft. thick.) It is entered by a slope 2,000 ft. long, ventilated by furnace, and lit by open lights. These Nova Scotia coals are slightly less bituminous than those of Cape Breton, known as Sydney coal, and are very well adapted for steam-raising purposes, and perhaps in a less degree for coke, although the several seams turn out an excellent coke; pertain to the bituminous system of Dana; the same geological horizon of the carboniferous system as those of England and Eastern America; and with the bituminous coal of New Brunswick, form an important section of the coal belt which nature has wound around the northern portion of the globe.

CAPE BRETON.

General Mining Association of Landon.—From 1785 to 1827 275,000 tons of coal came to bank, and on January 1, 1827, the mine passed into the hands of the present owners, who operate.

The Sydney Mines.—The Main seam, 5 ft. 4 in. thickness, is wrought by the pillar-and-bord system at an average dip of 1 in 12. It is entered by an 800 ft. shaft (bords 16½ ft. wide) and lighted by Mueseler lamps and naked lights. It is ventilated by means of Guibal fans, and is wrought by some 600 persons, inclusive of bank labor, producing about 160,000 tons of coal per annum. The mine is splendidly equipped with every requisite, and the produce is analysed as follows:—

	Slow coking.	Fast coking.
Moisture	·420	·420
Volatile combustible matter.	34·962	37·110
Fixed carbon	59.993	57·845
Ash	4·625	4·625
	100·000	100·000
Sulphur	·95	·95

Bridgeport Colliery.—The Phelan seam, 6 ft. thick, is wrought by the pillar-and-bord system, at an average dip of 1 in 11. It is entered by a shaft 120 ft. deep; open lights and furnace ventilation being employed. It is operated by sixty persons, and in 1891 the production was 30,000 tons of round coal. The drainage is natural.

Caledonia Coal Company, Glace Bay.—This company holds two square miles of coal land, operating a seam 7 ft. in thickness, with a dip of 1 in 10, and entered by a shaft 185 ft. deep. and a slope of 1,600 ft. The seam is wrought by the pillar-and-bord system, and is ventilated by two brick furnaces. Naked lights are used, and the machinery includes a 20 in. by 30 in. piston-inlet Ingersoll engine, feeding twelve coal-cutters; 400 persons are employed, and 150,040 tons of coal were produced in 1891, distributed among the markets of Nova Scotia, New Brunswick, Prince Edward Island, Quebec, Newfoundland, United States, Miquelon, and others, of which the most important is Quebec. The following are the analyses:—

Volatile matter	33·00
Fixed carbon	57·37
Ash	9·63

Cubic feet of gas per ton, 9,700.

Gowrie Coal Company, Cow Bay.—This company holds an area of two square miles of coal land, and operates Gowrie Colliery, of which a description was recently given in our columns. Since that article appeared the mine has been equipped with a 16 in. by 24 in. Ingersoll piston-inlet air-compressor, to feed seven coal-cutters.

Glace Bay Mining Company Limited.—This company holds 3¾ miles of coal land, and operates the colliery of Glace Bay, and holds the artificial harbor of Glace Bay, thereby extracting tolls from their contemporaries for shipping privileges. These areas include the "Hub" seam, 9 feet thick, which is easily worked, and of unsurpassed quality, and the Harbor seam, 6 ft. to 7 ft. thick, out of which the best gas coal of Cape Breton is produced (capacity, 10,000 cubic feet per ton). It is a locomotive and house coal, and analyses thus:—

Volatile matter	30.21
Fixed carbon	67·78
Ash	2·01
Sulphur	·90

The machinery is good, and the production was 108,600 tons in 1890, and 110,000 tons in 1891.

International Coal Company Limited.—This company holds five square miles of coal areas, and operates at the International Colliery at Bridgeport, the Harbour seam of coal, 6 ft. thick, dipping 1 in 12, by a 90 ft. shaft, and a 2,800 ft. incline from the base thereof. It is wrought by the pillar-and-wall system, 369 men and 50 boys being employed. Naked lights are used, and the ventilation is by means of fans. The analyses, as per seam of the Glace Bay Company, with varied percentages, are:—

		Per cent.
Volatile matter	Increase over Glace Bay seam	4.0
Fixed carbon	Decrease from do	4·86
Ash	Increase over do	0·98
Sulphur	do do	1·36

Sydney and Louisburg Coal and Railway Company Reserve and Emery Mines.—The Reserve mine, situate in the Bridgeport basin, produces the magnificent Phalen seam, 8 ft. 8 in. thick, dipping 1 in 13. The composition is:—Volatile matter, 37·26; fixed carbon, 58·39; ash, 4·35; sulphur, 2 06; gas capacity, 9,500 cubic feet per ton. It is wrought by the pillar-and-room system, and ventilated by furnaces. The slopes by which the seam is entered are as follows:—The Main, 1,782 ft. long; and the French, 3,498 ft. long; vertical depth, 257 ft. Beckett's lamps are used, and suitable machinery employed, including a 20x20 piston-inlet Ingersoll compressor, with a capacity for twelve Sergeant coal-cutters, eight coal mining machines, two drills, with augers and attachments. The production averages 131,000 tons per annum.

The Emery Colliery produces the excellent Ross seam, 5 ft. thick, dipping 1 in 12; gas capacity, 9,500 cubic feet. It is wrought by the pillar-and-room system, and entered by a shaft 80 ft. deep. The ventilation is by natural means. Beckett's lamps are used, and the production was 47,414 tons of coal during seven months in 1891, giving an aggregate for both mines of about 178,000 tons.

Low Point, Barrasois and Lingan.—This company operates the Ross seam, 6 ft. 7 in. thick, dip 25 degs. The analysis is as follows:—

	Slow coking.	Fast coking.
Moisture	·75	·75
Volatile combustible matter	26·85	32.13
Fixed carbon	68·13	62·85
Ash	4·27	4·27

Gas capacity, 9,500 cubic feet per ton.

The seam is entered by a slope 1,740 ft. long, out of which about 100,000 tons of coal are drawn per annum. It is wrought by the pillar-and-bord system, and some 272 men are employed. Mueseler lamps and naked lights are used.

The total production of the various Cape Breton collieries, the property of the companies here treated, according to Mr. Gilpin's report, were, during 1891, as follows:—

Name of colliery.	Raised. Tons.	Sold. Tons.
Bridgeport	36,897	32,457
Caledonia	159,985	144,995
Gardner	18.746	17,105
Glace Bay	117,767	110,212
Gowrie	158,064	152,367
International	133,179	124,677
Reserve	170,844	154,656
Sydney	170,691	146,645
Victoria	111,037	96,479

The comparative analyses of these with other coals are:—

	Volatile matter.	Carbon.	Ash.
Pennsylvania, U.S.A.	29·50	64·40	6·10
Virginia	33·68	57·76	8·56
Indiana	39·00	52·00	9·00
Illinois	36·59	59·47	3·94
Iowa	44·00	48·50	7·50
Missouri	34·06	50·81	15·13
Newcastle, England	37·60	57·00	5·40
Staffordshire, do	37·86	59·64	2·50
Derbyshire, do	35·10	61·65	3·25
Yorkshire, do	35·67	62·08	2·25
North Wales	36·56	57·49	6 25
Pictou, Nova Scotia	29·63	56·98	13·39
Sydney, Cape Breton	34·07	61·43	4·50

The number of accidents in 1891 was twenty, of which three were fatal, a list of casualties thus more excessive than that of Nova Scotia, where fifteen accidents occurred during the same period, none of which were fatal. The total amount of air measured in December 1891 was 343,632 cubic feet, 218,338 cubic feet less than the total amount measured in the Nova Scotian mines in the same month.

As to whether there is room for more mining enterprise in coal in Canada, I may say that I am distinctly of the opinion that either in British Columbia, the North-West Territories, Nova Scotia or Cape Breton proper, any colliery conducted upon fair and sound lines should earn a gradual increment of dividend. Of course, the coal operators of Cape Breton emphatically desire no more competition, but the coal operators are prejudiced, and prejudiced opinions are of no importance whatever.

Among all the vast centres of coal production of the globe, Nova Scotia ranks high for progressive legislation for her miners, and the superior social status thereof. During the year 1890, instructors were appointed at various collieries for the purpose of preparing persons desirous of presenting themselves as candidates for certificates of competency as underground managers—a position analogous with our own second-class certificated men—and overmen, and at an examination held on October 13, 1891, eleven certificates as overmen and twenty-three as underground managers were granted, the immediate benefit of which I, however, fail to perceive, inasmuch as wherever—as in Canada—undue protection afflicts a coal industry, healthy expansion is retarded, and if (as is here the sequence) no more collieries are to be opened up, where can positions as underground managers and overmen be found?

Trades unionism in Canada outside Toronto is of little importance, being marked by a strange lack of cohesiveness, which prevents too much arbitrariness upon the part of the men. Down in the coalfields of Nova Scotia no very acute strikes take place; the miners' unions are more passive than aggressive, and it is not to be anticipated that mining enterprise need fear much difficulty in this direction. The men are, however, not by any means free from folly in their unions, or outside in the village streets, and require a firm hand.

Meeting of the General Phosphate Corporation.—Accounts Not Yet to Hand.—Proposed Appointment of a Committee.

The third ordinary general meeting of the General Phosphate Corporation, Limited, was held on Wednesday, 22nd ult., at the Cannon Street Hotel, under the presidency of the Right. Hon. Lord Stalbridge.

The ASSISTANT-SECRETARY (Mr. C. S. Matz) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen,—In accordance with the note at the foot of the notice convening the meeting, I shall have to move the adjournment of these proceedings, but before doing so I must express my regret that the accounts have not been received from Canada in sufficient time for presentation to you now. We wrote from this side some months ago, and we have done all in our power to get them over. They are not here to-day, but we have every reason to believe that they will be over by the next mail. Therefore, in accordance with this notice, and feeling that as most of the shareholders had been kept away by it, it would not be advisable in any way to go into any question whatever, I will move "that this meeting be adjourned to Wednesday, 25th January, in order to permit of the completion and presentation of accounts from Canada." Before that is put, however, I should like to state that the Board, in the best interests of the Corporation, have agreed to ask for the friendly communications of shareholders, and we propose that a letter shall be addressed from the Board to the shareholders, asking them to place themselves in communication with each other as far as they can, in order that a committee may be formed who will confer with the directors, and who shall have everything at their disposal, of course, as far as is proper. I wish to repudiate in the strongest

way possible the idea that there is any wish on the part of the directors to hide anything. We court full publicity, and we think that in asking the shareholders to form a committee to confer with the directors—with which object I have already taken steps—we shall be able to have all matters thoroughly and clearly put before the proprietors, when they will be able to see for themselves the course which the directors have pursued. I beg to propose the motion which I have read.

The Hon. CECIL PARKER seconded.

Mr. HENRY GOOD rose for the purpose of proposing that the suggested committee be formed immediately. He was a dissatisfied shareholder, and he wished to give voice without delay to the dissatisfaction which he knew to prevail in the minds of the shareholders. He thought the course suggested by the chairman was the only one that could be adopted, and that it was a course which would receive the cordial concurrence of all the shareholders. But he thought the time was now at hand when they should give effect to that recommendation. He was aware that certain shareholders were engaged in litigation, or were threatening litigation against the directors, and he thought they should be exceedingly careful, when they appointed the committee, to select gentlemen who were thoroughly independent of all parties concerned. He was prepared to nominate a committee, and would do so if not out of order. He moved: "That a committee of five of the principal shareholders be appointed to inquire into the formation, purchases, and past management of the company, in order to ascertain whether the shareholders' money has been properly expended, and what steps are prudent to be taken by the shareholders—whether by future management, reconstruction or otherwise—to put the company's affairs on a satisfactory basis." He ventured to think that that conveyed no reflection upon the directors or anyone concerned in the company.

Mr. JOHNSON seconded the proposal of Mr. Good. He thought the suggestion of the chairman a capital one, and that it should be followed up immediately. In further remarks the speaker said he took up shares in the company because he saw the names of Sir James Whitehead and Mr. Sampson Lloyd on the prospectus, but he had heard with regret that day for the first time that Sir James Whitehead did not hold a share in the company now.

Mr. SMALL asked whether the proposal to appoint a committee at once was in order, in the face of the footnote on the notice calling the meeting.

The CHAIRMAN appealed to Mr. Good to abandon his motion, and to the shareholders to support his proposal for adjournment. The Board were pledged to the adjournment, and it would not be fair to absent shareholders to transact any other business.

Mr. GOOD, however, pressed his motion.

Mr. SMALLMAN was sorry the mover and seconder would not withdraw the proposal to appoint a committee. He agreed with the chairman that it would be unfair to absent shareholders to pass such a resolution, especially as there were many matters on which they wanted information before a committee commenced investigations. He had written to the directors asking questions on various matters, but they had not seen fit to reply to him, and he frankly admitted that he was not fully prepared at the present moment to ask all the questions he wanted to put to the Board. Before they appointed a committee they must have the accounts before them, they must know when proceedings were first commenced against shareholders in respect of calls owing, who else owed calls, and why they were not being proceeded against, because he found that the members of the Board were among the number. Examining the register ten months ago, he found, to his surprise, in respect of the call made in July, 1890, that hardly any of the directors made their full payments then. Some of the directors did not pay till February, 1892, and at the present moment Sir George-Baden Powell was in arrear to the extent of £100. He would suggest that the directors, in sending out the notice for the adjourned meeting, should send out a list of those who had not paid their calls, and give their reasons for not taking proceedings against them. There were other matters to be gone into, including the relations of the Board with the promoter.

After some discussion as to which of the proposals before the meeting had precedence in the matter of voting, the Chairman put his motion for adjournment, which was agreed to.

In the course of a discussion which took place subsequently, the chairman stated, in reply to a shareholder, that Sir George Baden-Powell had resigned his position in the company.

Mr. GOOD: Will you give me an assurance that my motion shall be put on the agenda for the next meeting?

The CHAIRMAN: Yes. (Hear, hear.)

The proceedings then terminated.

Petroleum Engines in Mines.—The arbitrators have decided the question raised by the inspectors of mines on the use of petroleum engines in mines, and declare that their use is not dangerous. A series of experiments have been carried out at the maker's works, and evidence was taken. A number of recommendations are made as to the carriage and storage of petroleum underground. In the course of the proceedings it was stated that there are only three or four mines where these engines are in use, but that the engines possessed considerable advantages for hauling, pumping and drilling in underground work.

MINING NOTES.

[From our Own Correspondents.]

Nova Scotia.

Cariboo District.

This district has been brought into prominence during the last three months by the success which has attended Mr. Geo. W. Stuart's management of the Truro Gold Mining Company's property. During November and December the old mine plant was completely removed, the boiler properly re-set, a new engine placed, hoisting gear remodelled, new shaft and ore houses built, together with other buildings, and the mine pumped out and again producing quartz in the incredibly short time of twenty-six days. We believe this breaks the record for Nova Scotia. The result of the first clean up after the rebuilding was 750 ounces from 30 tons milled.

The Dixon mine continues to yield its average returns, and reports from this property are satisfactory to shareholders.

Killag.

Reports from this district are to the effect that the lode worked by the vertical shaft shows well at the 100 foot level, and is reckoned worth one ounce to the ton. It is nine inches in width. The mill, which started up in December, has run very smoothly and satisfactorily.

Montagu.

With the departure of Mr. Woodhouse, "official reports" from this district have ceased, and no large bars are apparently forthcoming. On reliable authority it is stated that the rock milled in November and December was low grade. The present manager, Mr. Thomas, is endeavoring to open the mine in a systematic way, and the district now has the best chance for being thoroughly proved that it has had during its thirty-two years of life.

Waverley.

The West Waverley Gold Co., limited, are preparing to sink another lift in their main shaft, to open levels 100 feet below the present set. The ore found in present levels is very low grade, and the management expect to get a better grade by sinking.

The East Waverley Tunnel Co., (Messrs. Gue & Wilson) are driving on the barrel lode, which is reported as showing well. An air drill plant will be put in commission next month, when the main cross-cut tunnel will be continued to strike other lodes lying further east.

Oldham.

The "*Columbia Gold Mining Co.*" (which is the name the Attleboro-Providence syndicate has bestowed upon the property lately purchased in this district),) raised steam and started the mine pump on the sixth of the month. The company purchased the entire outfit of the defunct "Huntington Reef Co.," near Yarmouth and transported it to Oldham. The machinery is mainly from Fraser & Chalmers, Chicago, and is ample for a much larger property than the company now has. The boiler is 60"x14', engine, 16"x24', with cage for vertical shaft (not in use), mine cars, etc., a Lidgerwood hoist, 10 stamps of 850 pounds each, with water tank, plates, pipes, etc., etc.

The Oldham Gold Co. closed its Baker mine on Wednesday the 4th inst., and began the work of raising the pumps and saving such material as was valuable. It is understood that the 200 foot level south from No. 3 shaft will be prospected by a force of four men for a month or so yet, but all other shafts and openings have been definitely abandoned.

Next summer other lodes on the property will be prospected, and work on the West Dunbrack lode will be vigorously continued during the winter.

The Rhode Island Co., working on the western extension of the Dunbrack lode, have cut large quartz (from 6 to 10 inches thick) at a depth of 175 feet. This quartz shows some gold, with associated minerals, and the management express strong hopes of coming on a chute of pay ore.

Malaga District.

It is reported that the Malaga Mining Co. closed down its works on the Rabbit lode the first of January. This company's product for 1892 was between 1,300 and 1,400 ounces. There are many other lodes on the property that are pay lodes, according to good authority.

The Boston Gold Mining Co. are reported to have made a promising discovery of higher grade ore. The product fell off somewhat in August and September, but it is believed that the new discovery will bring the gold for 1893 up to the standard.

Fifteen Mile Stream.

The Egerton Co. and the Stanley Gold Mining Co., in this district, are reported as having consolidated their properties, and to be perfecting plans for development. Both properties have good records.

Renfrew.

The sale of machinery and personal property of the Empress Co., at this place, advertised for the 21st December, was postponed until March next. The judgments against the property aggregate $4,000 and upwards. It is understood that the sale in March will include the mines, as well as the machinery and plant.

Goldenville.

Mr. Jas. A. Fraser has purchased the "Meridian" and "Chicago" properties here for about $3,000, and rumor says will operate the same next season.

The district is very dull, absolutely no mining being carried on this winter.

Cape Breton.

Subjoined are a few brief notes in regard to the work done in 1892 at the various Cape Breton collieries.

General Mining Association.

(*a.*) "*Old Sydney*" *Mine.*—This colliery leads all the others in quantity shipped by a very handsome margin, and has established a record, not only for itself, but for the island. It has always been looked upon as the leading colliery in Cape Breton, and only once, viz. in 1891, when it was outstripped by the Gowrie and Reserve mines, has it failed to stand at the head in the list of shipments. Outside the ordinary work, the only noteworthy improvement effected last year was the lining of the main pumping shaft at the "Princess" pit with cast iron tubbing to a depth of 330 feet. The pit is 11 feet in diameter, and it took 1,179 pieces of tubbing, each cast to the curve of the shaft, and the weight of all was 378,000 lbs. The tubbing was all cast at the company's own foundry. Three hundred feet of this shaft had been tubbed while the pit was being sunk to keep back a feeder of water, so that the shaft is now lined with cast iron to a depth of 630 feet. Its total depth is 709 feet. The last "tubbing" was done for the purpose of preserving the shaft sides which were wasting away, owing to the heat from the steam pipes, combined with the water from the pumps.

(*b.*) *Victoria Mine.*—A very material progress has been made at this colliery in the quantity of coal shipped, and it now takes rank well up among the leaders. No work of note, outside the ordinary routine, has been done here, but regretful reference must be made to the terrible accident that occurred on Christmas eve, when, through one of the boilers exploding, three poor fellows lost their lives, while two or three others were more or less injured. The other boilers were dislodged from their seats by the force of the explosion, and the effect of course was to render mining operations out of the question for some time. The company are putting in a new boiler supplied by Messrs. Robb, of Amherst, N. S. Mr. Thos. Brown has recently been made assistant manager here, under Mr. R. H. Brown, the agent of the Association.

Gowrie Mine, Cow Bay.—The Messrs. Archibald & Co. are to the fore, although not quite in front this time, with a shipment of 138,500 tons. The Gowrie has been making steady progress for some years past and is now second to none in public estimation as a steam coal. Last year Mr. Charles Archibald extended his deep 300 yards, and drove a new level east off the deep. He put in an Ingersoll air compressor, and is now driving the pumps in the mine with air instead of steam. A new pump was put in the lower deep. The greater part of the shipping wharf was re-trestled, and the greater part of the main pier new fendered, the planking renewed, and new drop and shoot frames erected. Satisfactory prospecting was done on the company's third lease with the diamond drill, and a six-foot seam traced all along the outcrop for half a mile.

Sydney and Louisburg Coal and Railway Company.—This company shows up well with a shipment of 136,000 from the "Reserve" and "Emery" pits. We do not know of any noteworthy feature in the year's work. The Ingersoll air compressor stationed at the Emery pit continues, we believe, to give satisfaction in working the coal cutting machines in the mine, and also in pumping. The management has recently offered up praise and thanksgiving for the discovery of a large body of coal underlying the "Reserve" area that was hitherto unknown and unexpected. It subsequently transpires, however, that the existence of this body of coal has been known to every one, except the present officials, for many years past, and the shout of triumph has been abruptly stilled. A little work was unexpectedly done on the new coal area towards the close of the year, but was quickly discontinued.

The International Coal Company.—This company, foreseeing a falling off in the demand for coal, did very little banking in the early days of 1892, but their work after navigation opened was fairly brisk. They had the honor of establishing a record on July 9th, when they raised 1,452 tons from their shaft between 7 a.m. and 6 p.m. On this day they shipped over 2,700 tons from their Sydney pier. The company erected last year a slack bin adjoining their heapstead, into which the slack is conveyed from the screens for storage. The bin has a capacity of 750 tons, and the slack can be rapidly loaded into cars when occasion requires. It has been proved to work admirably and to be a great saving as regards time and expense. The heapstead has been raised and rearranged so that the coal as it comes from the shaft can be handled with more ease and expedition than before,

and by only half the number of men that were formerly required. The company's railway is quite a feature in their business, as, in addition to carrying their own coal, they carry the coal from the Old Bridgeport and Gardener collieries, and maintain a regular passenger and freight service between Sydney and Bridgeport. In addition to carrying and shipping the output of the Gardener colliery, the International Company has for the past two seasons purchased the output of the Old Bridgeport colliery, and disposed of same along with their own coal. They have also during the same period purchased about 50,000 tons coal each year f.o.b. from the Little Glace Bay Company, and carried same to Montreal in their own steamers.

Caledonia Coal Company.—This company shows a heavy falling off in their shipments for 1892, as compared with 1891. The principal cause of this was the loss of a large portion of the C.P.R. contract in Montreal, in which contract they participated to a large extent during the preceding seasons. The diminution in work done has not prevented the management from spending a considerable amount of money during the year in some very substantial improvements to the works. Foremost amongst these has been the acquisition of an Ingersoll air compressor, with which some coal cutting machines are worked, and a considerable amount of pumping done. A blast is also furnished therefrom to the blacksmith's forge. This addition to the plant has given the management every satisfaction. This company has kept up during the season its reputation for the rapid loading of their time-chartered steamers.

Little Glace Bay Coal Company.—The season was not marked by any unusual features for this concern. They shared in the general falling off in shipments, but managed to do an excellent business. The larger portion of their coal was purchased by the International Coal Company f.o.b. for disposal in the St. Lawrence market. The company has not been behindhand in improving their plant, having erected a new hoisting engine during the year, and also a new and powerful pump. They have also gone largely into the coal barge business and have now three barges of the whaleback type carrying their coal to Halifax, Prince Edward Island, Newfoundland and elsewhere. Towards the end of the year the company purchased the Steamer "Gulnare," which has of late years been employed by the Imperial Government in surveying the North American waters, to replace the tug-boat "C. M. Dinch," which they have so far used to tow these barges.

Old Bridgeport Colliery.—This colliery has been leased for several years past from the General Mining Association by Mr. Henry Mitchell, who has for two seasons past sold his output at the pit's mouth to the International Coal Company. On the 31st December it passed altogether into the latter company's possession, having been purchased by them from the General Mining Association. Under the new ownership it is expected that operations will be carried on upon a largely increased scale. The management of this mine under the late lessee, Mr. Henry Mitchell, has been highly successful.

The Gardener Coal Company.—This is the infant colliery of Cape Breton, but although the youngest, it has already given abundant evidence of great precocity. First started in 1891, it has mote than doubled its sales in 1892 The Messrs. Burchell Brothers have shown great push and enterprise in capturing a fair share in the local markets. They have been aided in their efforts by the excellent quality of their coal which is especially popular as a steam coal. This is the only colliery where an Electric Coal Cutting Machine (Jeffery make) has been used in preference to those worked by air. We understand the Gardener Company are getting excellent results from the machine in their pit. Under the vigorous management the Gardener mine is fast assuming the look of a busy and thriving colliery.

Ontario.

During the month a miner named Enos. W. Bingley, working at the Blezard Mine, fell from the top of the shaft, a distance of 145 feet being instantly killed.

The Engineering News, under date of 19th, has the following regarding the Central Ontario Iron Mines:—"Central Ontario Iron Mines.—The mines owned by this company at Coe Hill, Ont., were expected to do a very large business, and at one time a considerable quantity of ore was shipped to Cleveland, O. The United States duty of 75 cts. per ton, however, makes it difficult to find a market in this country, and the establishment of ironworks in Canada does not seem very probable, as stated in the "Canadian Notes" in our issue of Nov. 3. The suggestion has been made to establish charcoal pig works at the mines. One Pennsylvania ironworks proposed a few months ago to take some ore if it could be delivered at the works for $4.38 per ton. The ore is said to have 68% of metallic iron, with no phosphorus, but a disadvantage is its large proportion of sulphur, although modern improvements in the treatment of sulphury ores will probably eliminate the objection. Mr. T. D. Ledyard, of Toronto, in writing of these mines, says that the sulphur entails an additional cost in roasting; but that where other injurious elements are absent, a sulphurous ore, after being properly roasted, can often be used in the manufacture of Bessemer iron. In the report of the Royal Commission on Mines and Their Development, 1890, it is stated that "it seems to be three shafts, one 140 ft. and two 150 ft. deep. They are filled with surface water, but the pump pipes are in place, and it is said that no water was encountered in working." The hoisting plant is in good condition, and includes a powerful Gates (Akron, O.) winding engine and two boilers. The mines are now in charge of Mr. Johnson, the company's Foreman of Mines, who is an experienced Welsh miner, and is prospecting for the company. When at work night and day, the output was about 50 to 100 tons per day. Samples of the ore have been selected for exhibition at the World's Columbian Exposition."

British Columbia.

From our Kaslo notes it will be seen that there are 17 mines going to be worked in the Slocan district all winter. Suppose those mines employ six men each, on an average, this means 102 men at work, and a pay-roll behind Kaslo of over 10,000 a month. This estimate is, from the nature of things, rough, but it is certainly not over-stated. Several deductions may be made from it which will help to bring the wealth of the Slocan before outsiders. Suppose the camp remains stationary for six months, or 150 working days, and that each man is responsible for half a ton of ore averaging net profit of $100 per ton, that represents 7,050 tons of ore; say that shipping expenses and net profit come together to $175, the result would be $1,338,850 for the six months' work, of which $765,000 would represent the profit to the mine owners. Or take another way of looking at it. Let us say seventeen mines include all the good properties in the Slocan. If, while doing development work and employing six men each on the average, they are capable of producing $1,300,000 in six months, what will be their outpnt when fully opened up and employing from twenty to thirty men apiece? Having worked out this little sum in proportion, let the outsider consider what part of the available wealth of Slocan is represented by seventeen claims, and then let him figure the whole thing out on the same basis, and he will have some conception of the fnture which every inhabitant sees sticking out big before this country—*Miner.*

The secretary of the Westminister Slate Company has been notified that the contract for supplying slate to be used on the roof of the new drill shed at Victoria had been awarded to his company. The value of the contract is something in the neighborhood of $1,500, and the number of slates contracted for is 30,000.

Duplicate samples of coal from the various collieries are being sent into the government office to Mr. M. Bray, who will forward them through Mr. A. Dick, inspector of Mines, to the Imperial Institute at London, England, and to the Columbian exhibition at Chicago. From the Protection Island mine and from the Wellington colliery blocks of coal of extra large proportions will be exhibited.

From a gentleman recently from the Cariboo country it is learned that the Victoria Hydraulic company and the South Fork company have been doing a good season's work on the Quesnelle Forks. The Victoria company have completed about 12 miles of ditch, five feet on the bottom, seven feet on the top, and two feet deep. Water from this ditch can be taken from Spanish creek to either the North or South Forks. There is a quantity of gold in the country, but it takes a heavy outlay to open things up. The time so far has been spent in getting matters into shape for next year. The Victoria company has a mile of iron pipe to connect with the from Spanish lake. They have not yet reached bedrock, though they are down about ninty feet in good ground.

The South Fork will do well during the coming year, as from present indications some eight or nine months working can be done. Each company has been employing a large force of men this year, and cousiderable work has been done. The South Fork company has finished eight miles of ditch four feet on the bottom and twenty inches deep.

W. W. Purdy is in town with a choice collection of mica brought down by him from his claim, 8,000 feet above sea level, on the Rocky Mountain range, and distant from Kamloops some 276 miles. The district is parctically unknown, and Mr. Purdy himself cannot do more than locate his clam. It adjoins that of Louis Vie, of Kamloops, who located on the information of Indians, who spoke of "glass in the ground." The samples brought down by Mr. Purdy run from six inches to three feet square, and are really beautiful. Even the croppings are superior cuts. There is said to be an illimitable quantity of the mica.

CANADIAN COMPANIES.

Leeds Copper Co.—At the annual meeting of the Leeds Copper Company, Limited, held on the 29th ult., voluntary liquidation was decided upon with a view of reconstruction. The capital of the existing Company is £285,071 in fully paid shares of £1, and for each old share it is proposed to issue one new share of 2s., with 1s. credited as paid.

Ontario Natural Gas Co., (Ltd.)—Is applying to the Dominion Government for Supplementary Letters Patent increasing the capital stock of the Company to $500,000.

Canadian Copper Company.—Several prominent Canadian attorneys have been in Cleveland, O., on an important mission. It is an examination ordered by the High Court of Justice of Canada in the suit brought by the Central Ontario Railway against Senator H. B. Payne, Judge Stevenson Burke and H. P. McIntosh, of Cleveland, and S. J. Ritchie, of Akron. The claim set up is that funds of the railway were illegally diverted from the railway to the Canada Copper Company and the Anglo-American Iron Company, of Canada, and several millions of dollars are involved. Judge Burke is president of the railway and both the other companies and the other defendants are stockholders in all three of the corporations.

Canadian Pacific Prospecting and Mining Co., Ltd.—The annual meeting of the Canadian Pacific Prospecting and Mining Company, Limited, is to be held on the 11th inst. The Company has a subscribed capital of £10,000, of which £3,808 has been received. In the report to be presented to the meeting, the directors state that it has been suggested by some of the shareholders that the Company be wound up, but Mr. E. E. Rand, one of the directors who has just returned from British Columbia, is so impressed with the recent development of the mining industry in that country that he has advised the Board to defer the liquidation for a few months, as it may be possible during that period to acquire the option of a property with a view to its flotation in London or Canada.

British Columbia Coal, Petroleum and Mineral Company, Limited.—Formed to acquire by purchase from the Crow's Nest Coal and Mineral Company, (Limited), all their real and personal property for the sum of four million dollars, to be paid in fully paid up shares of the Company, and for the purpose of acquiring coal lands and lands producing coal oil and other lands, and working the said lands in a workmanlike manner for the purpose of getting and mining coal and coal oil and other minerals therefrom, and selling or leasing the same; and also for the purpose of guaranteeing the debentures or bonds to be issued by the British Columbia Southern Railway for obtaining money for the construction of the said railway, from Michel Creek, Crow's Nest Pass, to the international boundary, and thence to connect with some railway in Montana, U. S. A.; such guarantees to be limited to $25,000 per mile for 175 miles of railway. Capital $4,000,000, in $40,000 shares of $100. Trustees, Joseph D. Pemberton, E. G. Prior and Wm. Fernie, all of Victoria, B.C. Head office, Victoria, B.C.

The Van Winkle Consolidated Hydraulic Mining Company, Limited.—Formed to take over and acquire mining leases of the lands known as the Van Winkle Bar, in Yale district, B.C., and also certain grants and water rights, dated 27th October, 1892, granted to Frances Helen de Wolff and to William Monro, and to acquire all the rights and interest of all the parties interested in what is known as the Van Winkle Bar, and the water privileges in connection therewith, also to carry on hydraulic or other mining. Capital, $500,000 in 50,000 shares of $10. Trustee, R. G. Tatlow, A. T. Ceperley, J. M. Buxton, E. Mahon, and George de Wolff. Head office, Vancouver, B.C.

Alberta Railway and Coal Company—Gives notice of application to Parliament for an Act to extend the time for completion of its railway to Fort McLeod, and thence to and through Crow's Nest Pass and British Columbia, and to authorize it to lease or sell and convey to the Canadian Pacific Railway Company those portions of its railway and charter rights in respect thereof extending from (1) Dunmore to Lethbridge, (2) Lethbridge to Fort McLeod, (3) Fort McLeod to and through the Crow's Nest Pass and British Columbia, or from Dunmore to and through the Crow's Nest Pass and British Columbia, or any one or more of said portions of their railway, or to enter into an agreement with the Canadian Pacific Railway for giving them running powers over any or all of said portions of their railway, or for the operation by the Canadian Pacific Railway Company of any or all of said portions of said railway.

Strathyre Mining Company, Limited—Gives notice of application for Dominion Charter of incorporation. Authororized capital $125,000 in 1,250 shares of a value of $100. Directors, Duncan McIntyre, Montreal; R. B. Angus, Montreal; H. C. Hammond, Toronto; W. C. Van Horne, Montreal; C. R. Hosmer, Montreal; L. J. Forget, Montreal and Thos. G. Shaughnessy, Montreal Head office, Vernon, B. C. George Attwood, M.E., F.G.S., Consulting Engineer. Formed to acquire and work tracts of mineral lands in the Province of British Columbia and elsewhere in the Dominion. At date it owns and is operating certain gold properties at Fair View Camp, in the Okanagan district, B.C.

Asbestos Company of Newfoundland, Limited—Registered by E. Eady, 8 Glenlyon-Terrace, London W., England. Capital £10,000 stg. in £1 shares Formed to carry into effect an agreement with R. H. Jones of the one part and E. W. H. Eady, on behalf of the Company, of the other part; generally to search for and deal in asbestos and other minerals. Directors J. W. Shepherd and W. R. Mitchell.

Y-One Mining Company.—The regular annual meeting of the stockholders of this company was held in Chicago, November 9th last, and the following directors were duly elected: John T. Huntington, Col. J. S. Morgan, John W. Lewis, H. S. Sprague and P. N. Taylor. At a meeting of the directors held at the company's business office, 29 Euclid avenue, Cleveland, O., on November 15th, Col. J. S. Morgan was elected as president and general manager; John T. Huntington as vice president and aesistant manager; John W. Lewis, secretary and treasurer, and Prof. R. J. Grant as superintendent of mines. President Morgan made a verbal report on the condition of the company affairs and property; he said a tunnel had been started in the fall to cut the five ore veins that are known to exist on the property. The tunnel has now reached 120 ft. from its entrance with a backing of 75 ft. The main edge on the property is exposed in the bed of Silver Creek for a distance of 80 ft. by 20 ft. wide, and assays from $143 to $223 per ton silver. The company intend erecting a concentrating plant of machinery on the property early in the coming spring, when concentrates and ore of very high grade will be shipped to the United States for treatment.

Shafer Gold and Silver Mining Company.—Registered under the Companies Act, (B.C.) to carry on the business of mining for gold and precious metals in British Columbia. Capital, $400,000. Head office, Ainsworth, B. C.

New Explosives.

According to experiments by Cronquist, the blows required to explode the following explosives, each about 0·4 gramme in weight, were approximately as follows:—

	Foot-Pounds.
Nitro-glycerine	2·1 to 5·7
Dynamite	3·5 " 12·8
Gun-cotton, dry	5·7 ....
Gun-cotton with 20 per cent moisture	16·5 ....
Sebastine	4·9 ....
Romite, common	4·3 ....
Romite, naval	13·7 ....
Powder, (fired only)	271·2 ....
Bellite	448·4 ....

According to Lindall, on the other hand, plastic dynamite is much more useful than romite or bellite, which are also very much lighter—as much even as 40 per cent. Comparative experiments between plastic dynamite and bellite which were made near Stockholm showed advantages in favor of the former, though Cronquist states that bellite shows not the least trace of flame on explosion. A mixture of 20 per cent. of dynamite with 80 per cent. of ammonia powder is also stated to be a very safe explosive as regards freedom from flame.

Nordenstrom observes that explosives, such as romite and bellite, which contain hydro-carbon derivatives, have as yet been comparatively little used in metal-mining. Fifty tons of romite was used at Gellivaara, but details are not available. These explosives are of little value for wet holes, and require much stronger caps than those usually employed. On the other hand, their transport is a matter of very little danger.

According to E. Pellissier, comparative trials have been made in the district of Linares, Spain, of an explosive called nitramite and gelatine dynamite. In hand-boring the nitramite, though somewhat less powerful in its action, showed a saving in the expenditure, and this saving became considerable when compressed air boring was employed. In this case, too, the work performed in the twenty-four hours was greater in the case of nitramite than when dynamite was used. The tunnel being driven was advanced in the twenty-four hours 33.39 inches when dynamite was used and 34.97 inches when nitramite was employed, the respective costs being 2s. 11d. and 2s. 6d. per shift. The author observes that the action of the nitramite, though less violent than that of the dynamite, is more shattering. He recommends that in using nitramite the cartridges should be placed well home in the bore-hole and in intimate contact with each other, but not in any way compressed. The detonator must not, on any account be allowed to detach itself during the charging of the hole from the central portion of the cartridge, as this has a different composition. If there is water in the bore hole, extreme care must be taken that none of it penetrates into the cartridge or detonator. This requires peculiar care if the charge is to be fired after filling the bore-hole with water. The chief experiments in Spain with this explosive have been carried out at the Arraynes mine under the direction of P. P. de Uhagon. The rock bored through in the experiments to which reference has been made, was granite in the case of the hand-boring, and vein stuff with some granite intrusions in the case of the machine-drilling.

A commission appointed by the Belgian government has recently experimented with a new explosive. This is stated to be named "Fortis," and to be from 30 to 40 per cent. more powerful than any other explosive known. A comparatively small charge placed in a 13-foot bore hole in the face of a quarry dislodged a mass 200 feet in height, breaking it up into pieces mostly of from 50 to 60 pounds n weight, and hurling some of these for a distance of 350 yards.

O. Muhlhauser describes an explosive made from hemp, and named nitro-hemp (nitro-jute.) It is produced by treating one part of hemp with fifteen parts of nitro-sulphuric acid at a temperature of 15° C. After washing, this material is a brownish-yellow silky-looking wool, having the composition $C_{12} H_{15} O_5 (ONO_2)_5$. It is insoluble in water, ether, benzine or alcohol, but is soluble in ascetic ether and nitro-benzine, or partially in ether-alcohol. In its explosive action it is almost identical with gun-cotton.

A new explosive named "Nico" has been tried at the corporation quarries, Clifton Hill, Melbourne. A 4-foot hole in the toe of a solid piece of rock was charged with one and a quarter pounds of cartridges and a little loose powder, the hole being too large for the cartridges. A second hole 6 feet deep was similarly charged with two and a half pouuds of such powder, and a third with two pounds. Each of these shots gave successful results, as also did a number of others.

Methods of Testing Explosives.—To ascertain the duration of the explosive action, P. Vielle has devised a registering crusher gauge. A steel point attached to the steel plug which compresses the copper cylinder in a crusher gauge apparatus, is used to trace a curve on a revolving cylinder which is driven at a speed of about 33 feet per second. The pressure of the gases generated by the explosion can be calculated from the composition of the explosive, or can be found from the deformation of the copper crusher gauge, while the pressure at any instant can be found from an inspection of the curve. By means of this apparatus it is found that the duration and also the manner of combustion varies very greatly with different explosives.

Fan-Testing Gauges.—Some notes on fan gauges in connection with fan-testing and the adaptation of fans to mines, and also a comparison of the fan and furnace at Silver Hill colliery, are given by the Rev. G. M. Capell. It is considered that the most satisfactory position for taking the gauge is 6 to 10 feet away from the inlet in the larger part of the fan-drift. The German practice of deducting the work of fhe air due to its velocity is not considered fair. After many observations, the author advises that the end of the gauge should be plugged with cotton-wool and wrapped with soft flannel; but definite rules for the position and use of water-gauges ought to be drawn up and adhered to in all fan-tests. Where fans have taken the place of furnaces, some curious results have been observed, and this may arise from the fact that the gauge in furnace ventilation does not account for the shaft friction in the up-cast and down-cast shafts. Direct calculations probably give too high results for these factors. The author then proceeds to give the results of some tests with furnace and with fan ventilation, to illustrate the difference in the gauges obtained by the two methods.

Association of Apatite with Beds of Magnetite.—The frequent association of apatite in layers in the midst of magnetic iron ore, according to Mr. W. P. Blake, is significant of a stratified and organic origin of both minerals. The phosphate is usually more abundant towards the sides of the bed than at the centre, where the iron ore may be free from phosphorus, and near the planes of contact of the ore with the country rock apatite may abound. Several instances in which this is the case are given by the author. The Sanford ore bed in Northern New York carries large quantities of apatite in thin layers apparently interstratified or the result of segregation. This mineral, known locally as red sand, is most abundant towards the confines of the bed. Crystalline apatite may also be found in the outer layers of the bed of ore at Iron Mountain, and similarly in some of the beds of magnetite in Southern Utah.

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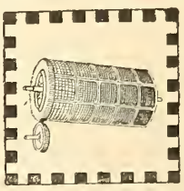

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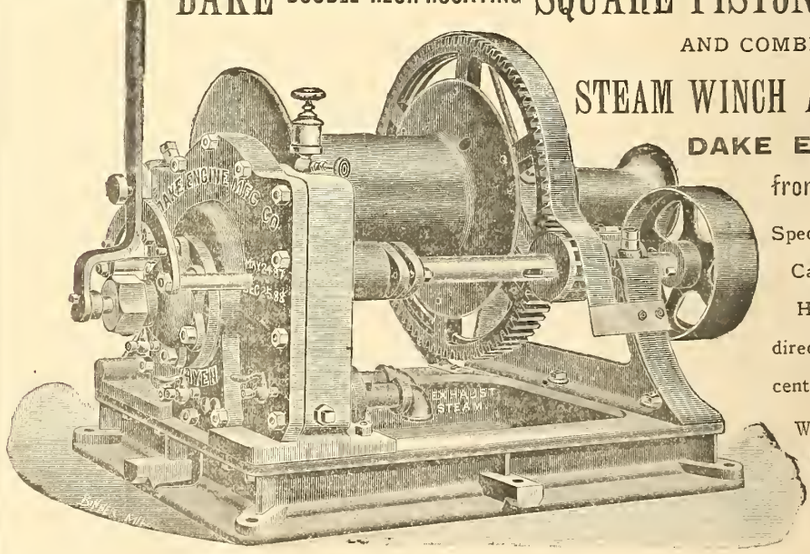

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Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

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All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

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Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

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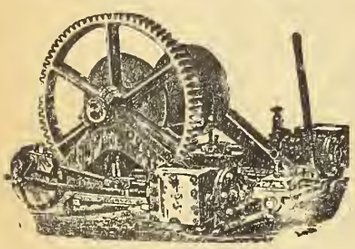

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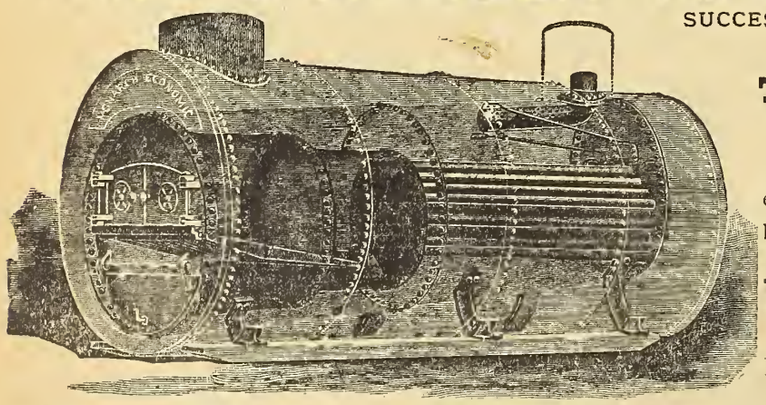

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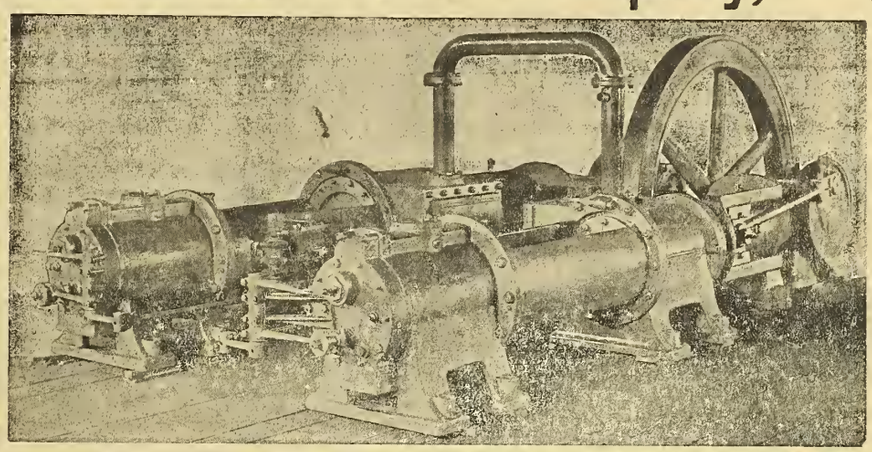

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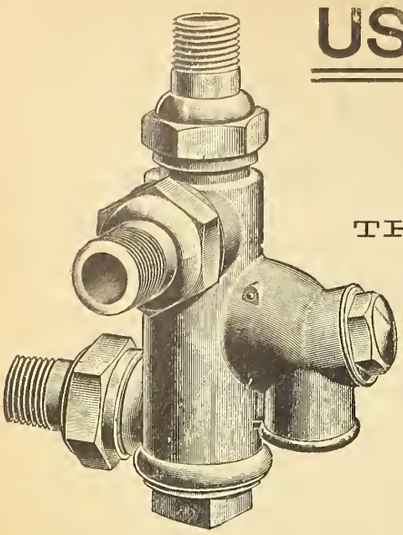

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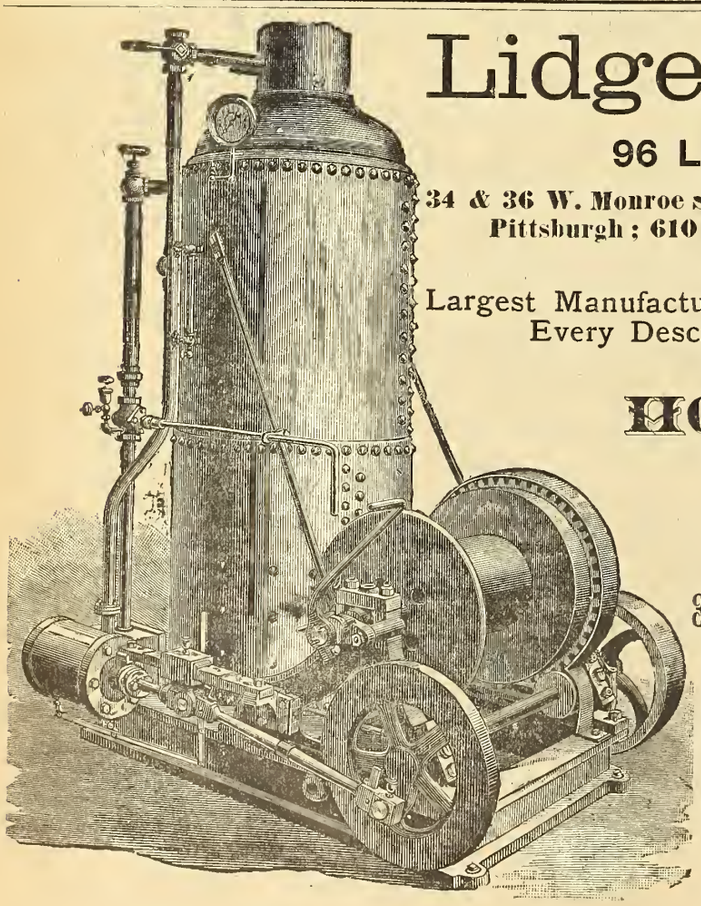

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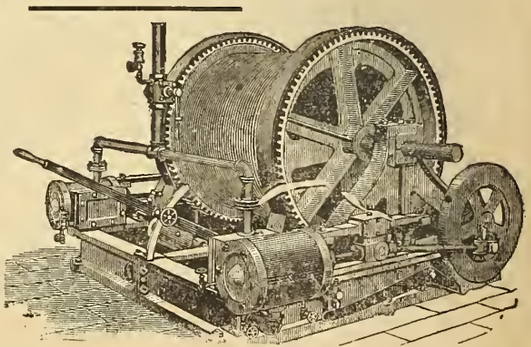

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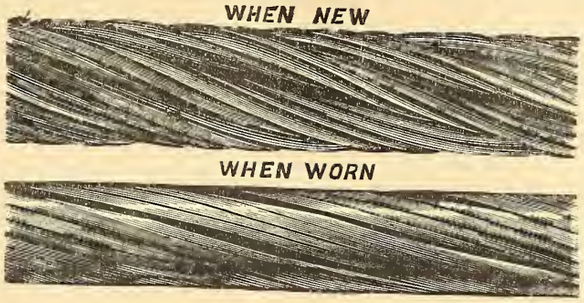

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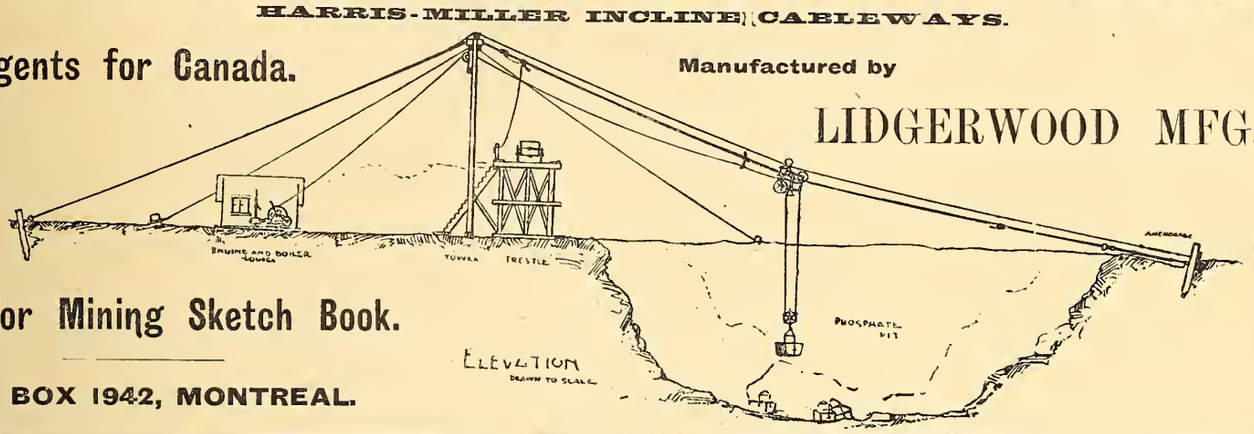

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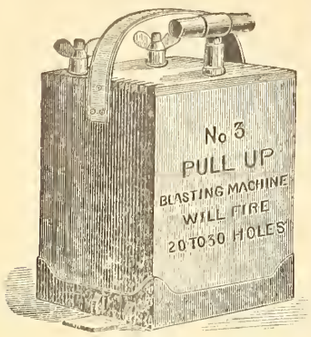

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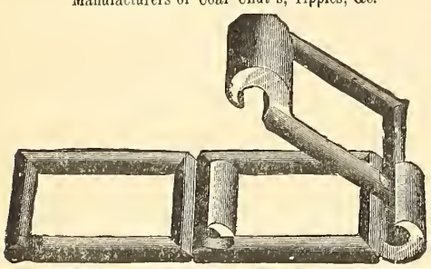

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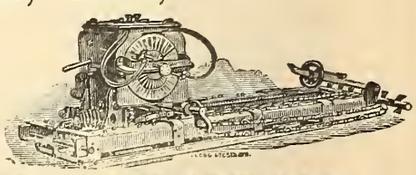

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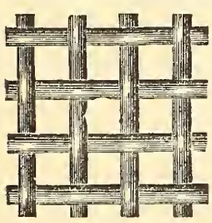

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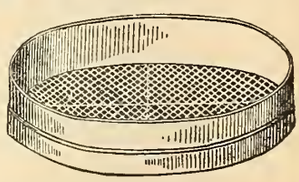

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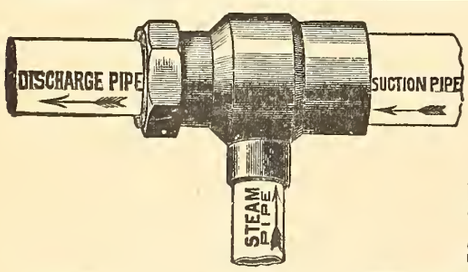

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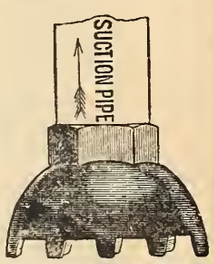

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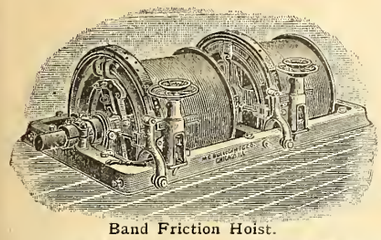

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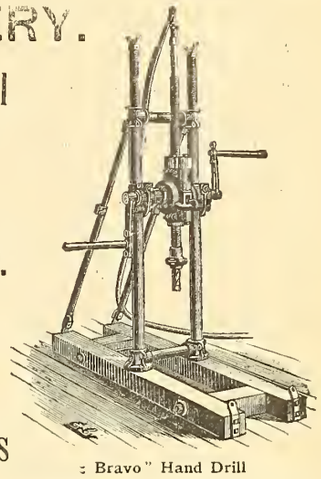

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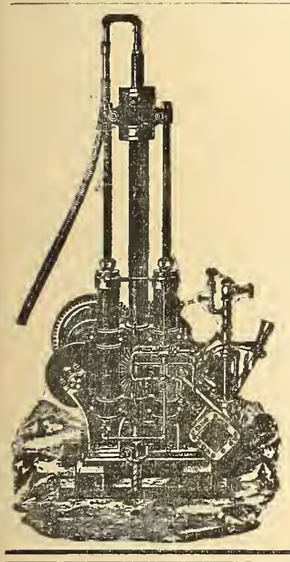
Capacity, 400 ft., 1 3-4" hole, 1 3-16" core.



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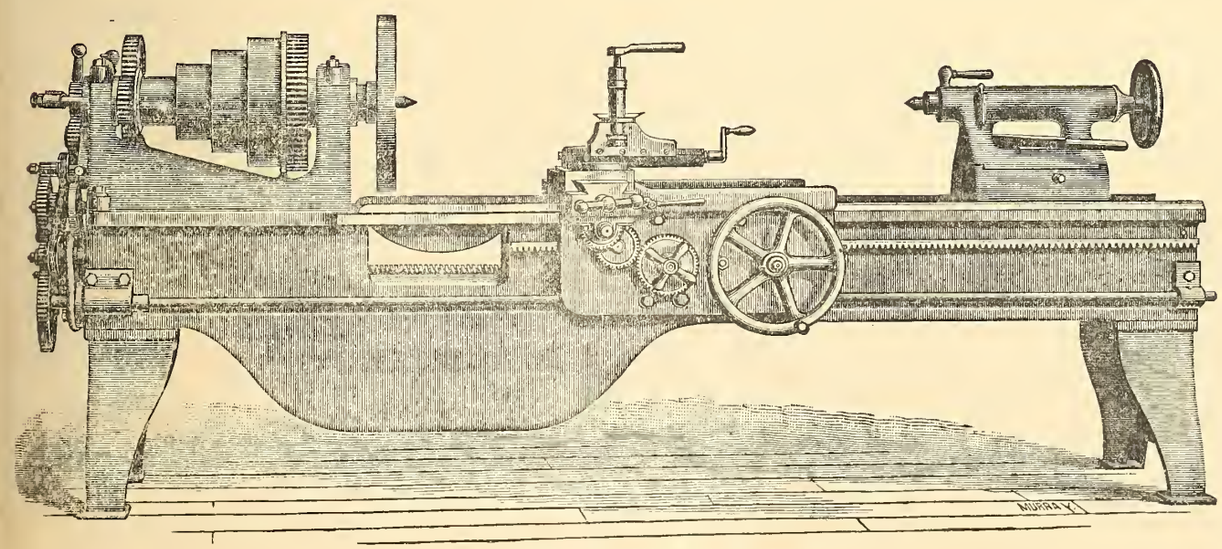

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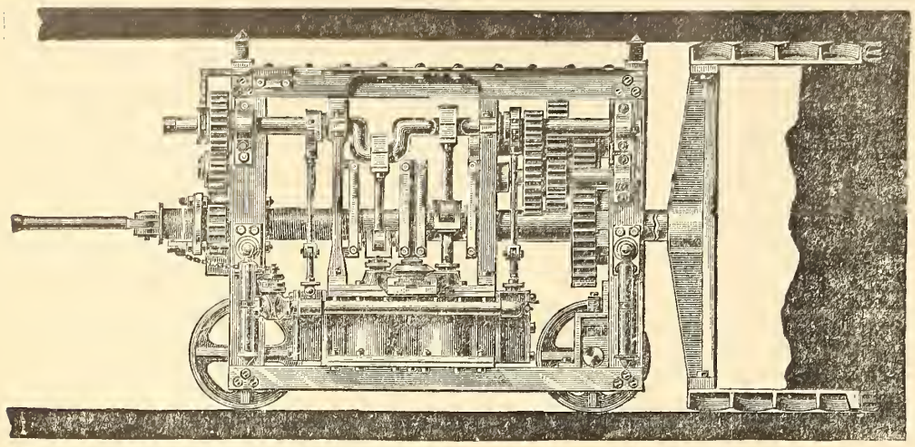

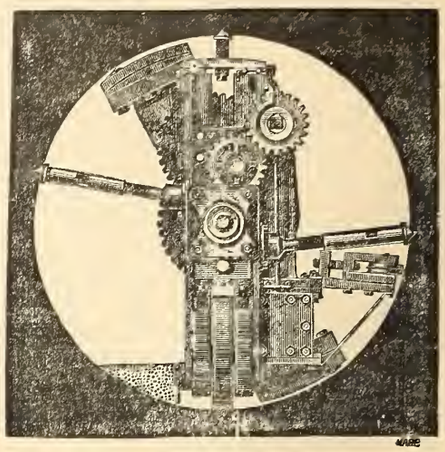

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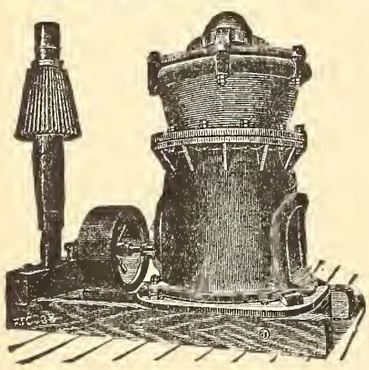

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Size 0— 2 to 4 tons per hour.
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" 2— 6 to 12 " "
" 3—10 to 20 " "

Size 4— 15 to 30 tons per hour.
" 5— 25 to 40 " "
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Passing 2½ in. ring, according to character and hardness of material.

GREAT SAVING IN POWER. *ADJUSTABLE TO ANY DEGREE OF FINENESS.*

The principle involved in this Breaker is acknowledged to be the greatest success ever introduced into Stone Breaking Machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of Breakers combined.

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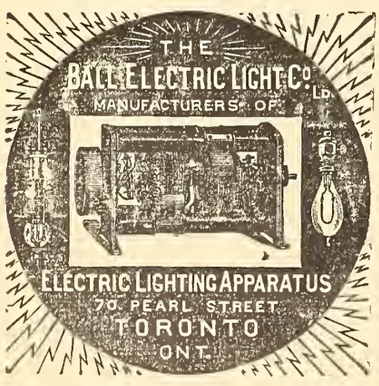

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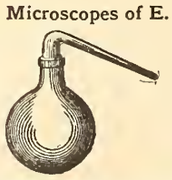

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ANY person may explore Crown Lands for minerals. Mining lands may be taken up as surveyed locations or staked claims.

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Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

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Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

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PROSPECTING LICENSES up to 100 areas, (each 150 feet by 250 feet), issued at 50 cts. an area up to 10 areas, and 25 cts. afterwards per area, good for one year. These Licenses can be renewed for second year, by payment of one half above amount.

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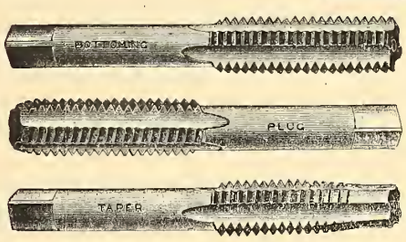

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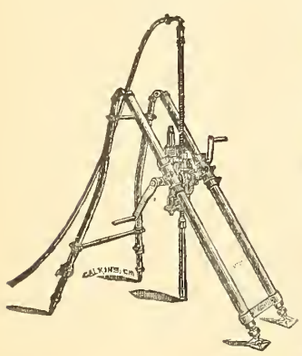

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Capacity—300 ft. depth.

Removes $1\frac{3}{5}$ inches solid core.

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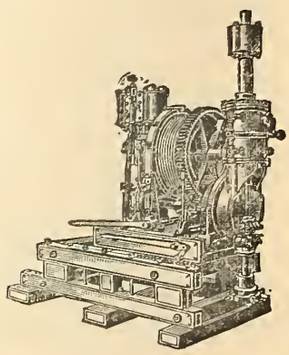

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$10,000 have already been expended in developing the property, and the Company is now running a drain tunnel which will tap the shaft at 35 ft. deep and open up strata of rich pay gravel.

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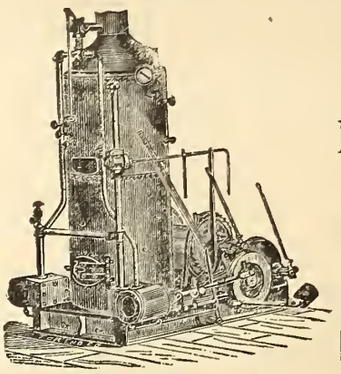

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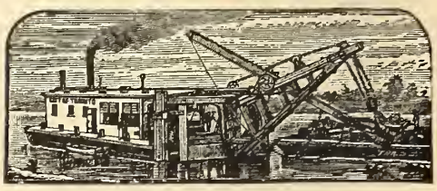

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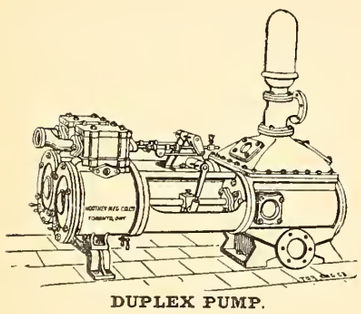

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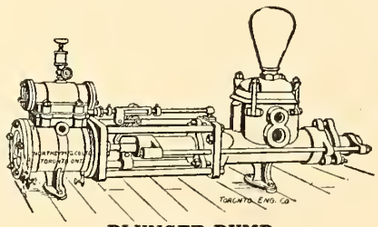

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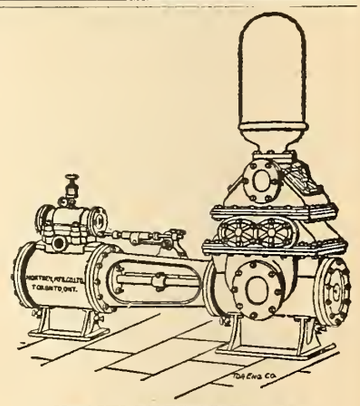

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THE OFFICIAL ORGAN

—OF—

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THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERAL MINING ASSOCIATION OF QUEBEC.

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries :—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

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Canadian Mining Investment.

At present a great deal of attention is being attracted towards British Columbia as a field for investment in gold and silver mining operations, but we are told that nine-tenths of all the work in the new districts is being done by *Americans*, as the people of Canada are content to call the residents of the United States. It is of primary importance that the country should be developed no matter who does it, and we have no sympathy with those who abuse foreigners for exploiting the treasures which Canadians leave unsought. But we should be glad to see a greater spirit of enterprise awakened among our own capitalists. We know of several cases where enterprises in our own country, offered first to Canadians and declined either through timidity or apathy, have been promptly undertaken by Americans. A correspondent from the far west writes: "It seems a little odd to me that the Canadians sit idly by and let the Americans take all the good things, and then wake up after all is over and howl about the Yankees getting the best of everything. While it is well to be conservative, there is such a thing as being too slow." The same correspondent, however, states a fact that explains some of the caution felt by our capitalists. He says: "Some of our people are a little disgusted because some of the Slocan people sold them twelve-eighths in one property, and they are now busy trying to figure out what interest the last four purchasers have. But such is life. The poor prospector must be fed." It is this frequency of fraud as well as the uncertainty of mineral deposits that occasions hesitancy to invest. Some of our capitalists, instead of waiting for the scheming promoter to come along and unload his "wild cats" on them, are sending trusty men into the new regions and getting properties direct from the Government, or at first hand from the discoverers at comparatively moderate prices. In such cases there is a large chance of success, and mining becomes a legitimate and tolerably safe business. We would urge our capitalists, where they can intrust their money to men in whom they have confidence, to take risks in uncovering the vast riches that nature has deposited in our hills, rather than to employ their means in gambling in stocks and betting upon futures in wheat and pork. Apart from the money side of the question, they would gain an added interest to their lives in knowledge of new regions with all the romance of discovery and growing development. A great deal of money is being made in the Kootenay District, and it has attracted such capitalists as Rockefeller. Mineral locations that cost $500 from the Government, are changing hands at from $10,000 to $100,000, and town lots that six months ago sold for $50, now are eagerly bought for $500. Men of energy and enterprise have a good chance to "feather their nests."

The National Museum.

"The necessity of enlarged and more secure housing of the magnificent collection of the Geological and Natural History Survey of Canada at Ottawa."

Such is one of the topics which is to occupy the attention of mining men in Montreal next month, on the occasion of the 64th annual meeting of the American Institute of Mining Engineers, and of meetings and conventions of every mining society in Canada. The question is one of vital importance, it is one which has more than once been brought forward before the public in the columns of the CANADIAN MINING REVIEW, and no amount of pressure or solicitation on the part of the press of Canada will cease until "the magnificent collection," to quote the words of the resolution, finds an adequate and fire-proof building in which the natural and attractive resources of our great Dominion can with safety be kept for reference.

Not to speak of the educating influences of such a museum on the masses, which may be judged from the annual visits of some twenty thousand persons who register their names at the door. The natural collection on Sussex Street, Ottawa, affords mining men and practical geologists, agriculturists as well as those interested in natural science as a study, a most excellent means of judging for themselves of the VAST MINERAL WEALTH and the variety of it in Canada. In this great Dominion of ours *we have* the rocks which—*par excellence*—carry minerals and mineral veins. The enormous development and distribution of primary rocks as we find them in Canada are such that no country in the world possesses so vast an extent of them, and these are metalliferous.

Our nickel, iron, silver, copper, gold and lead, and other metals are all found in these rocks, and it is now only a question of a proper acquaintance with the nature of these deposits, with the extent and practical usefulness of the ore, that we can begin to develope our mines with due regard to location, market and demand.

The cases of the Geological Museum on Sussex street are filled to overcrowding, and the building contains specimens of ores and minerals from every province, and mining district of the Dominion.

It is essentially a NATIONAL COLLECTION. Members of Parliament and those interested in the growth and welfare of this country, from whatever district they come, may see within the walls of the "old Clarendon House" specimens illustrating the resources of the county or riding they represent or from which they come. Ottawa, as a political centre, is visited annually by hundreds of persons from the old world and by more from the south of the boundary line. In a few moments, after spending—say, only a morning, or better a single day—such individuals as desire to become acquainted with the ore deposits which characterize Canada may do so with entire satisfaction. And, moreover, the information to be received there is reliable. Everything in the Museum tends to the practical. Besides the specimens of ores which are carefully labelled as to locality, exact and definite, as to the nature and quality of the ore, accessibility etc.—there are samples of material applicable to the arts, manufactures, for building purposes, for fertilizing the soil, for lighting and fuel purposes, gems, mineral waters, brines, salt and all such useful resources which it would take more space to catalogue than the present article demands. Suffice it to say that the verdict not only of Canadians who are justly proud of their natural collection at Ottawa, but visitors from other countries have time and again been struck with the REMARKABLE COMPACTNESS, UTILITY and perfect classification of the Museum. But outsiders, visitors from the United States, Great Britain, and from many other countries in Europe, have referred, in scientific and other periodicals, as well as in the public press, to the richness and beautiful order of the collection. AND TO THINK THAT IN ONE NIGHT IT COULD ALL BE DESTROYED BY FIRE. Every now and then we have a narrow escape of losing this grand collection. A fire-scare comes every time the alarm is sounded from the district adjoining, and of all the buildings which the Government owns at present at the capital there is not one so little fire-proof as the Geological Museum. Many visitors from the United States and Europe have called attention to this collection, and the names of

Prof. James Hall, of Albany, N. Y. State Museum; Prof. J. K. Ward, Rochester; C. D. Cope, Philadelphia; C. D. Walcott, and many others in Washington; Dr. F. Schmidt, of St. Petersburg, Russia; and Dr. Woodward, of the British Museum, and scores of others in Germany, France, Sweden, including Baron de Geer, Herr Lundbohm, Barrois de Lille, Count Marazzi, and many others who have written on this subject.

It is a matter for our politicians to tackle and at no distant date. THE SOONER THE BETTER. The present accommodations are not only too dangerous, but likewise too small and inadequate to meet the growing requirements of Canada. Hundreds, nay thousands, of specimens are added which help to make the series of Canadian ores and useful natural resources more complete. Explorations in Nova Scotia, New Brunswick, Quebec and Ontario, as well as those in northern Manitoba, in British Columbia and in the remote portions of the Territories, such as the Yukon, Peace, MacKenzie, Reindeer and other river districts, have contributed, and are still contributing, a vast amount of material which give a good practical idea of the nature of the earth's crust at those points.

Canada has still vast regions of unexplored territory. The great North-West on one side of Hudson Bay; the great North-East on the other side of the same great Sea, count hundreds and thousands of square miles of unexplored country, and who can fortell what these regions may produce?

The gold of the Yukon, the tar of the Peace River, the coals of the great North-West, the iron ores of the Labrador peninsula, and in fact all the resources of remote districts are still in their infancy. The timber and agricultural capabilities of Canada are vast. They vary according to the soil and rocks from which these are derived. Canada has the BEST WHEAT GROWING MATERIALS in its soil of any country in the world, and that in enormous quantity.

The Geological Museum contains, besides the rocks and mineral specimens of the Dominion, a very valuable collection of Indian remains which serve to write up and illustrate the history, manners and customs of the tribes in Canada These are unique in many respects, and additions are constantly made by the staff on the different explorations. Then the collection of plants and woods; these are very valuable indeed. It is the most perfect herbarium of Canada, and represents its flora very strikingly—from the boundary line to places within the Arctic circle. All these together with the Library of the Survey, which is fast becoming a source of valuable information for the study and development of our natural resources, the Chemical Laboratory, also thefossil specimens which illustrate the past life—both animal and vegetable on earth—the fur-bearing and other animals, birds, reptiles, etc.—all from Canada. These all, indeed, form a collection of which our young country can feel proud.

Not too much stress can be laid on the fact that specimens from HUNDREDS OF LOCALITIES cannot be exhibited for want of space, and all that is exhibited runs the risk of being burned up. "The Museum is on fire," and the "building is destroyed" may any day be the cry whilst the unique collections which it has taken the staff fifty years to gather together will be forever obliterated and could not be replaced. There are type specimens of incalculable value to science. No intrinsic value can be placed on certain specimens. They serve to show the resources and history of our country, and should be placed in a commodious fire-proof building where there would be good light and offices for the staff, in which the officers would not be in danger or dread for their lives by the tumbling or caving in of the floors or walls.

The time has come for the Government of Cauada to house these valuable collections properly, place them advantageously and in a fire-proof building in some spot where the general public and citizens can easily reach it. The money could not be better spent, seeing that Canada already possesses these collections, and if they are kept from destruction the annual increase and additions to them will soon make it a complete and most useful storehouse for Canada's products of the forest, land, stream, seas and rocks. A national collection would tend to increase the country's interest and cement the bond of union between the provinces, and at a glance the products of one district could be seen to be specially adapted to the products of the other, and in an harmonious whole all would tend to the upbuilding of a bright and prosperous Dominion, whose territory can safely support some 50,000,000 people. The mineral wealth of Canada is scarcely known as yet. Everything is in its infancy. We earnestly hope that this suggestion, which our mining men assembled are going to discuss, will become a reality.

The Cape Breton Coal Syndicate.

Idleness, or very intermittent work, has prevailed at the Cape Breton mines since the Christmas and New Year's holidays. The "Old Sydney" mines have done a fair amount of shipping to Halifax and Newfoundland, but with this one exception, the mining done has been insignificant. Some of the collieries are now starting, or preparing to start, banking out coal, and in a short time this kind of work will be general. A feeling of uncertainty and speculation pervades all classes dependent on the coal trade just now, and much anxiety is expressed to know what the present situation is going to hatch out. The much talked-of syndicate has taken shape and developed with great rapidity of late, and is now accepted as a *fait accompli* in mining circles. Naturally enough it is the topic of the day, and many and various are the opinions advanced as to the good or evil that is ikely to accrue from it to the general and individual interests. We think it may be truthfully stated that the impending change is viewed with complacency, and perhaps with hopeful feelings, by the laboring classes. They expect to see things "hum" around our collieries and shipping ports, and if modern and labor-saving appliances are used to an extent hitherto unknown, the great increase that is confidently looked for in the amount of work to be done, will more than compensate for this from their point of view, and cause a considerable if not a corresponding increase in the demand for labor. A wail is raised on behalf of the poor "coaster," which, it is feared, will be "wiped out" by the introduction of barges, but the season of 1892 must have demonstrated to the owners of small schooners that coasting, as far as coal is concerned, is now a business flat, stale and unprofitable, and it will be hardly fair to lay the blame for the destruction of this as a money-making business at the doors of the new corporation.

Among the outside public the question seems to have been viewed with tolerable equanimity, and in many cases with feelings of lively satisfaction. The opposition that has been offered locally has taken a political complexion. It would be altogether unfair to say that the Conservatives as a party are opposed to it, but it is nevertheless a fact that the strongest opposition in Nova Scotia has come from two of the leading Conservative organs in the province, while *vice versa*, the syndicate has found its strongest adherent in the Halifax *Chronicle*. The reason for this is not hard to seek. Premier Fielding has got hold of a very good thing, and his friends are jubilant over it. Mr. would-be-Premier Cahan and his friends are a little envious and cross about it. The consolidation of the mines in Cape Breton (which is the only mining district in Nova Scotia affected or likely to be affected by the change) will mean a large increasc in the provincial revenue. The new corporation is prepared to pay handsomely for a form of lease of longer duration and more definite in its terms than those that have hitherto been granted. Mr. Fielding, in fact, has struck a "pay streak," which should mean for him a long continuance of the power he has wielded for some years past in Nova Scotia. However this may result, there can be no doubt that this form of raising money will be far more legitimate and by far less demoralizing for all concerned, than the methods recently in vogue. A good deal has been written by the Halifax and North Sydney *Heralds* lately on the subject of this American-Canadian combine, and it appears to us that these papers have indulged to a very large extent in what is known as "begging the question," in their opposition. For instance, they have advanced as an objection, the existence of an understanding between the Boston capitalists, who are the most deeply interested parties in the new concern, and Pennsylvania coal operators. This is all pure guess-work, and is, we are given to understand, utterly untrue. It would look to us as if, so far from being a combination of New England and Pennsylvania to stifle Nova Scotian competition, it is rather a combination of New England and Nova Scotia against Pennsylvania. At least, anyone who studies for a few minutes the position of Boston and New England in regard to the coal question, would favor this conclusion.

Then again the cry is raised that, with the mines all under one control, the price of coal will be instantly raised and a heavy burden thus imposed on Canadian manufacturers and upon consumers generally. This objection again, it appears to us, is more or less of a "bogey.' The same competition that regulates prices at present will still operate to prevent anything like extortion, under the new regime. It has been an "open secret" that all the Cape Breton mines have, for some seasons past, been acting in concert in regard to the prices of coal, both f.o.b. and delivered in Montreal and elsewhere. Is it not naturally to be supposed that they have got as much as they could safely ask for their coal during this period? The result of this wise policy on their part has not resulted in any hardship, but, on the contrary, in good to all concerned. Fair dividends have in most cases been paid upon the capital invested, fair wages paid to employees, and we are not aware that any consumer has complained of having been pinched by the combination that has thus practically existed. Can the new combination do much more than the old one did in this direction? It is well known that in Montreal and the St. Lawrence generally—whither the bulk of the coal from Great Britain is sent—prices cannot be forced beyond a certain point without at once letting in Scotch, English and American coals. So far from having the effect of raising prices in this market, the prospect is held out of very considerable reductions being made in the cost of transportation and landing of the coal and also in the price to be charged consumers, while Montreal may become a distributing point for coal for districts now altogether monopolised by our American cousins. These two objections are the most terror-striking of the numerous ones advanced, and, so far as we can judge, there is not much to them.

The further objection, adroitly used to cause a scare among the laboring classes, that it is the avowed intention of the new concern to take advantage of the most improved methods for saving labor and cheapening production, is not worthy of this nineteenth century in which we live, and is hardly worthy of notice. For one thing we strongly doubt its having the effect sought to be indicated, and anyway, the march of science and progress cannot be interrupted. It must and will go on, in spite of any interested clamour to the contrary. We are decidedly of the opinion that the quiet and self-respecting mining classes, now resident in Cape Breton, would welcome all the modern labor-saving machinery with more heartiness than they would the horde of Poles, Hungarians and Italians, with which the North Sydney *Herald* threatens them, presumably as the alternative for the said machinery.

In conclusion, while perhaps it is inevitable that individual interests will suffer here and there in a big deal of this nature, we cannot but think that on the whole, it is calculated to bring prosperity to Cape Breton and to give to the development of its mineral resources—coal being only one of them—an attention and prominence which it has hitherto lacked, and which it has been loudly calling for.

EN PASSANT.

When, at the last of the Session a year ago, clause 156 was unexpectedly added to the Mines and Minerals Act by the Government of Nova Scotia, those who had followed the legislation in connection with mining, at once remarked, "There is a nigger on the fence somewhere." Whereabouts they were in doubt but a short time, for very soon afterwards it began to be whispered options were being given of certain coal mines in Cape Breton, and that a deal to concentrate the mining interests in that country was in contemplation. While the clause in question at the time of its passage seemed to offer sufficient protection to the manipulators of the proposed deal it became evident to their cautious advisors that other safeguards to their title to the minerals in Nova Scotia were desirable, after the CANADIAN MINING REVIEW had so fully and clearly exposed the willingness of the Provincial Legislature to exercise their sovereign power and override prior obligations when impelled by pecuniary necessities. A power that could and did refuse to submit to the decision of a legal tribunal when lessees of mining areas complained that the sanctity of contracts made by them had been assailed by the arbitrary increase of "royalty" to be paid that Government during the currency of their leases. The lessees prayed that the good name of the Province of Nova Scotia should be cleared, by an appeal to the courts, of the charges of repudiation which was made on the passage of the Act increasing the rate of royalty, but this step the Government refused to sanction. Seeing this it became evident to the syndicate to ensure their title and to guard themselves from treatment similar to that which had befallen the capitalists who had been induced by the Legislature of 1866 to sink money in Nova Scotia mines, that they, as lessees, should have in the event of dispute with the Legislature of Nova Scotia as lessors an appeal to arbitration or the courts. For this purpose they applied for special legislation, which the Government was not only willing to grant, but even to call a special session of the Legislature to confer, provided the syndicate was willing to pay for it. The terms asked by the Government were a royalty per ton of twelve and a half cents and a minimum amount based on the output in 1891 of the mines over which they should assume control. These terms were accepted and the Government have confidently appealed to the Legislature to confirm them in the belief that the bargain is a good one for Nova Scotia.

The situation has made the coal mines of Nova Scotia the talking-stock of the continent, and the Opposition, who have of course objected to the Bill, have contended that the ultimate object of the syndicate is to play into the hands of American monopolists, and cut off competition from Cape Breton. A calm and independent consideration of the question leads us to conclude that the immediate effect of the combination of the mines will be to modernize their equipment, and reduce the cost of transportation of coal to chief centres of consumption. That this will be accompanied by a moderate advance in the price of fuel to the local consumers, is most probable. But instead of a reduced output, as foretold by the Opposition, we expect to see an enlarged trade and an extension to points of late beyond the access of the independent but small operators. We have, however, to agree with the Opposition that Nova Scotia is, for present advantages, discounting the future at a high rate, to tie up such a property as the coal field of Cape Breton for so long a term as 119 years, is undoubtedly unwise. The possibilities of that limited field are very great, its position on the sea coast and the cheapness with which its large seams can be worked, give it exceptional advantages which should not be tied up for so long a time.

It is amusing to see how the opinion of our good friend Attorney-General Longley veres to the necessities of the occasion. On January 12th, 1892, he desired to show that all previously existing leases terminated in 1886, and that what the lessees called "renewed leases" were "new" leases, and came within the scope of the Legislature of that date for new leases, and he wrote: "When August 15th, 1886, arrived, as I understand it, the Government of Nova Scotia were at liberty to take exactly the same course in respect to the coal mines of Nova Scotia and in respect to coal royalties, as they were in a position to take prior to the lease of August 15th, 1826. The Act of 1885 also * * * was a notice * that the Province not only had a right to absolute control in the amounts of royalty imposed, but * * held itself at liberty to exercise this right whenever it chose."

On January 25th, 1893, eager to justify the granting of an absolute lease for 99 years, with an extension of 20 years to the Whitney Syndicate, he, on the floor of the House when speaking of the existing leases, said: "By virtue of these leases, which are practically for 80 years, because in each of them there is compulsory right of renewal." Leases that in January, 1892, he says, were absolutely "new" in 1886, he declares in January, 1893, to be for 80 years from 1866.

In connection with the petition of certain lessees for disallowance of the Mining Act of 1892, we would respectfully call the attention of the Department of Justice to this change in the opinion of the Attorney-General of Nova Scotia.

A new principle of electrolytic separation of metals is said to have been shown by Freudenberg. According to Le Blanc, in a solution the amount of the electric charge is identical for one and the same ion, and that, therefore, the point of decomposition of an electrolyte may be exactly determined. As this value differs very considerably for the various metals, the author thought it probable that their separation may be brought about by employing currents of different E.M.F.'s, and the experiments already made

show that such is really the case. Thus, with a single Leclanché cell, having an E.M.F. of 1·35 volt, silver may be separated from copper and bismuth, and mercury from copper, bismuth, and arsenic. The analyses given show a very close agreement with the theoretical numbers.

Our next issue will contain verbatim reports of the proceedings of the International Mining Convention at Montreal.

At a recent meeting of the Manchester Geological Society, Mr. Henry Hall, one of the English inspectors of mines, contributed an interesting paper on the danger attending the recovery of unexploded shots. He said they all knew what a missed shot was, and having had a missed shot, they were bound to deal with it in some way or another, but what they did not know was how to deal with it with comparative safety. He had consequently brought this subject before the association, with the object of getting some information as to the best course to be pursued under such conditions as he had stated. The position seemed to be this, that assuming for a moment a missed shot in a narrow place, the first thing the man would do would be to connect an additional piece of wire to his firing wires and tie it on to the props. He would then proceed to drill another hole, and try to drive out the original shot. When the second shot went off, and he found that, instead of the charge having blown out the missed shot, it had simply blown down his coal and left his shot in the solid coal, the question then arose, what was he to do under the circumstances? Was he to drill another hole, and try to blow out the charge, or was he to try and get the missed shot out of the coal without exploding it? When he found his original shot not blown out he was not likely to go to the trouble of drilling another hole, and consequently he proceeded with his pick to try and recover the missed shot from the solid, an operation which was attended with the utmost possible danger. That this danger was very serious was shown by the number of accidents which had taken place recently, and this large number of accidents made it very clear that something must be done. The danger seemed to arise, first from the low temperature at which the detonators would explode, and to the impatience of a collier in dealing with a missed shot under the conditions he had referred to. The only conclusion he had been enabled to come to was that they should make it a rule that no person except the shot-lighter or fireman should take any part in the recovery of a missed shot. and that even he should not adopt the plan of picking at the unexploded charge. He was not going to say that such an operation was actually unramming, although it approached very closely to it. He thought it was quite clear that they would be doing right to forbid a collier to take any part in the recovering of a missed shot. So far as he could judge there was no rule in the Mines Regulation Act that was better known to the collier than the rule with reference to his not being allowed to unram, whilst there was no rule the collier thought less of breaking, and the rule was broken every day. So far as the general safety of a mine was concerned the sooner any operation connected with the recovery of a missed shot was taken out of the hands of the collier the better.

In a paper before the Illinois Mining Institute on the subject of coal cleaning, Mr. Thomas Stocket, M. E., claimed that two points are essential for good cleaning. (1.) Evenness and regularity in passing the coal from the hopper to the screen, which insures every separate piece touching the screen proper and passing on to the table or belt in such shape that refuse may be readily detected. (2.) Good light, and an abundance of it, which can be secured by the construction of large windows on the sides of, and skylights directly over the screens and belts.

At the October meeting of the Engineers' Society of Western Pennsylvania, Mr. Joseph H. Eastwick read a paper on the "World's Supply of Nickel." He mentioned the nickel deposits at various places in the United States which may be valuable, principally in Oregon, Nevada and North Carolina. A trial of the North Carolina ore by Mr. Mixer, of the Edgar Thomson Steel Works, was rather discouraging. It averaged about 2 per cent of nickel, although samples have been obtained running up to 10 per cent. The Nevada ores are abundant in quantity and comparatively rich, but they are arsenides of nickel and difficult to refine. They are also far from railroad facilities. The Oregon ores are of the silicate class and have not been developed in commercial quantities. During the discussion the question of welding nickel and iron was brought up. Mr. Mixer said that he had examined rolled sheets made in Cleveland, O., of nickel and steel. Looking at the edges of the sheet, it could not be determined where the nickel ends and the steel begins, but of course the outside is mostly nickel and the inside steel. The nickel is welded to both sides of a sheet of steel. It makes a non-oxidizable article having the stiffness of ordinary steel, and convenient for various uses. Mr. Mixer pointed out that the small percentage of nickel used in steel is not likely to increase the demand for nickel so much as is generally thought. The Edgar Thomson people had received from Commodore Folger a bar of nickel steel containing 25 per cent of nickel. It was about 2 inches in diameter and very tough, and a steel chisel was ruined trying to cut through it. It took a beautiful polish. It is obvious that for many purposes a steel with a high percentage of nickel may prove very valuable.

Comparative Statement of Coal Deliveries to St. Lawrence Ports, for the Years 1891 and 1892.

Name of Colliery.	Montreal.		Sorel.		Three Rivers.		Quebec.		Totals.	
	1891.	1892.	1891.	1892.	1891.	1892.	1891.	1892.	1891.	1892.
	—	—	—	—	—	—	—	—	—	—
Cape Breton:										
General Mining Association.	40,819	75,547	26,840	1,589	4,173	9,012	24,011	30,472	95,843	116,620
Reserve	84,082	74,326	8,317	4,358	4,300	.....	11,212	9,419	107,911	88,103
International	103,969	77,758	.....	1,233	.....	.....	4,954	7,620	108,923	86,611
Caledonia	69,317	73,225	18,764	.....	.....	.....	940	.....	89,021	73,225
Gowrie	58,200	68,198	1,806	1,845	.....	.....	2,599	3,293	62,605	73,336
Glace Bay	53,324	43,676	.....	.....	.....	.....	412	1,723	53,736	45,399
Gardiner	.....	.....	.....	.....	.....	.....	.....	5,521	.....	5,521
Pictou:										
Intercolonial	40,420	79,155	.....	4,566	.....	.....	276	.....	40,696	83,721
Vale and Acadia	4,193	.....	.....	.....	.....	.....	.....	.....	4,193	.....
Foreign:										
Scotch	15,193	23,236	.....	3,103	.....	.....	11,078	12,395	26,271	38,734
English	5,282	6,190	.....	.....	.....	.....	7,844	5,177	13,126	11,367
American Bituminous	.....	3,450	.....	.....	.....	.....	.....	.....	...	3,450
	474,799	524,761	55,727	16,694	8,473	9,012	63,326	75,620	602,325	626,087

Recapitulation.

	Tons.		Tons.		Tons.		Tons.
1885	360,000	1887	482,103	1889	467,525	1891	602,325
1886	377,500	1888	517,539	1890	543,656	1892	626,087

CORRESPONDENCE.

Ahn and Dr. Emmens.

TORONTO, Jan. 23rd, 1893.

Editor Canadian Mining Review:

SIR,—In reply to Dr. Emmens' letter in your last issue, allow me to state the following facts :—

During the fall of '91 I met in Toronto Dr. Emmens, and escorted him at my own expense to Sudbury for the purpose of showing him the nickel mines of that district.

During the months of February and April following correspondence was continued, and at Dr. Emmens' request I forwarded him a report on a property in Denison I had for sale. This report was approved and agreements signed and money put up for development work without any examination being made by the Emmens Metal Company. This I considered an unbusinesslike transaction on their part. It, however, proves that Dr. Emmens did not form the poor opinion of my ability he states he did in his letter to the CANADIAN MINING REVIEW, a further proof of which is his letter from Youngwood, April 27th, '92, wherein he writes as follows, referring to the arranging of matters as to the deal for the property in question :—

"I think you have held the scales very fairly and evenly between all parties, and I feel satisfied we are putting the mine in good hands by intrusting its working to yourself. I know you will do your utmost, not only as a matter of professional pride, but also as a fitting reproof to the Canadian Copper Company and other people who treated you so shabbily and tried to prejudice me against you when I was in Canada. I need hardly add that if the mine turn out well we shall be glad to intrust you with its subsequent management when we purchase."

The agreement entered into by the Emmens Metal Company was to the effect that in consideration of their receiving a four months' option, they agreed to expend the sum of sixteen hundred dollars ($1,600.00) in actual development work on the property. The only money they paid towards this amount was $700. My receipts show that I paid $200 more than I received.

After two weeks' work at the mine I found the surface ore playing out and dead rock appearing more plentiful. This was a repetition of what occurred at the Worthington mine, which is really a part of the same deposit, and the formation is identical. Of this change I wrote Dr. Emmens, and suggested stopping work until he could visit the property with me, which he had previously promised to do. He, however, sent his chemist to examine it for him, and on his return to Youngwood, Dr. Emmens wrote me as follows, June 16th, '92 :—

The opinion I have formed after considering your letter and my chemist's statements, is as follows :

The mine is a promising prospect but as yet shows no body of ore of commercial magnitude.

Such ore as is found is for the most part nickeliferous, and a portion is exceptionally rich in nickel.

No immediate supply of nickel by the car load will be forthcoming.

The chances are in favour of success being achieved. A good body or bodies of ore may exist. I think they do.

After this Dr. Emmens asked for an extension of the option, which was ultimately granted.

On August 2nd an expert arrived in Sudbury to examine this property on behalf of the Emmens Metal Company. In his report he speaks several times of a vein occurring, and in one instance mentions it as occurring 30 inches wide, and in another part speaks of an occurrence 3 feet wide, and from the various measurements quoted in this report, shows that in the opinion of this expert that a vein does exist which has been already exposed for over 150 feet. In the summary of this expert's report he states, "That a comparison of the geological conditions with those noticed elsewhere, the nickel-bearing minerals found and the local indications are all promising and indicative of improvement in depth as the property is developed. The ore bodies in this district are generally lens-shaped and the nickeliferous minerals are found in greater quantity where lines of fracture or fault occur, as shown in this property.

The development work done is not sufficient to enable any satisfactory estimate of ore in sight, &c.

Further, this expert figures out that 113 feet of the vein, assuming it to be 200 feet deep, will yield $18,080 worth of nickel and copper. To this must be added some considerable amount for platinum which Dr. Emmens reports occurs in some considerable quantities in the vein matter.

At the time my report was written the surface indications warranted everything that was said of the property, and three shots put in at different points threw out ore that assayed as follows: Sample 1, 7·10%; sample 2, 23%; sample 3, 28%. These samples were selected by some gentlemen from Rochester, and submitted by them to a reliable assayer with the above results.

The contract I signed to deliver ore at the price agreed upon. I signed not that I expected to be able to accomplish it without some small loss to myself, but I hoped by the appearance of the property to be able to make such a showing as would satisfy the intending purchasers. Had I declined to enter into the contract it would have shown that I had no faith in the property. This would not have been correct. I still believe it to be a valuable property and one that will ultimately prove itself equal to the Worthington.

Had Dr. Emmens mentioned in his letter that he had lately reopened negotiations wtth the owners for a purchase of this property, and upon their declining to take less than the original money for which it was offered, the real reason of his letter might be seen.

Were Dr. Emmens the honest man or gentleman he would have people think or believe him, he would not descend to the gutter to attain his ends, to say nothing of his sacrificing truth, which he has done either in his letter of April 27th or in his letter to the CANADIAN MINING REVIEW. And were he the experienced mining man he would have us believe, he would not expect to develop a mine for $700.

Yours, etc.,

R. H. AHN.

YOUNGWOOD, PA., Jan. 31st, 1893.

To the Editor Canadian Mining Review:

SIR,—I have read Mr. Ahn's letter of Jan. 23rd to you and I beg leave to comment thereupon as follows :—

1. Mr. Ahn makes no attempt to deny or explain away the specific instances of regrettable actions on his part to which attention is directed in the article published in your. December issue. If he wish to have the good opinion of the mining community he must not beat about the bush, and drag red herrings over the scent, and raise secondary issues. He must deal fairly and squarely with Messrs. Rickett's and Banks' report to the effect that they found no verification of his statement that "*the hill in question is almost a solid body of Millerite, Pyrrhotite and Chalcopyrite, all of a high grade.*" This statement was either true or false. No reference to the "contingencies of mining" or "the surface ore playing out" will suffice to justify it, if, in point of fact, the hill was *not* "almost a solid body, &c."

2. The second advance ($400) was made to Mr. Ahn on the understanding set forth in my letter of June 23rd, viz,—"We have decided to rely upon your deliberate expression of opinion that, with reference to Gersdorffite and Niccolite, you consider it possible to mine enough to pay the expenses of the development, by which we understand you to mean that we may reasonably expect to receive by August 31st sufficient high grade ore to amount, at $5 per ton, to the total of our advances. Upon this understanding we forward herewith a cheque for $400 as an advance on account of ores to be shipped at the rate of $5 per ton or else to be taken over by us on the mine at $3 per ton. Please therefore sign and return the enclosed form of receipt. In view of this decision I do not think it necessary to enter upon any technical discussion in reply to your letter. I will merely say that in acting on your advice we entrust our interests to your professional ability and good faith." The previous advance had been $300. The understanding therefore was that the Emmens' Metal Company was, by August 31st, either to receive 140 tons of "high grade ore" on cars at the Worthington station or 233 tons of "high grade ore" at the mine. Mr. Ahn received and appropriated the money on this understanding, although, at that time, the condition of the mine was such as to preclude any reasonable expectation of the promised ore being produced during the next two months. This action on his part was either honest or dishonest. It certainly has the appearance of having been a dishonest and ungrateful return for the confidence reposed in his "professional ability and good faith."

3. When Mr. Ahn shall have cleared himself from the foregoing clouds that at present obscure the brightness of his reputation as a mining engineer and as an honest man, I will deal, to any extent that he may desire, with all the secondary issues he can raise. For the moment the following brief observations must suffice.

a. When Mr. Ahn volunteered to travel in my company I understood that he was going to Sudbury in connection with his own affairs. I did not discover that his offer imposed upon me any obligation either in law or in courtesy to pay his expenses.

b. Mr. H. P. McIntosh, of the Canadian Copper Co. informed me in Sudbury that I was at liberty to visit the Copper Cliff works, but that Mr. Ahn would not be allowed on their premises. This and other instances of feeling adverse to Mr. Ahn came under my notice, but I would not allow them to bias my mind. I determided to treat Mr. Ahn as I myself would desire to be treated, and I acted towards him on the supposition that he was honest and truthful, simply taking care to word my letters in such a way as to show that I was putting him upon his honour and was giving him an opportunity to prove himself more capable and trustworthy than was opined by his detractors.

c. Mr. Landale, when taking the option on the mine, did not visit the property, because I had laid down the principle of development before decision. And our willingness to expend some money in developing the particular property in question was because we believed Mr. Ahn's report to be substantially true. It contained some proofs of limited technical knowledge, but we made charitable allowance for these, and were influenced by statements which simply raised the issue of truth or falsehood. We felt that although Mr. Ahn might be a poor miner and an ignorant mineralogist, he was surely capable of distinguishing between ore and rock. When, therefore, he stated that "the hill in question is almost a solid body of Millerite, Nickeliferous Pyrrhotite and Chalcopyrite all of a high grade," we believed that some considerable body of ore did, in fact, exist, and that development was warranted.

d. Mr. Ahn's statement as to my having lately reopened negotiations with the owners for a purchase of the mine is incorrect and misleading—wilfully so, if Mr. Ahn have seen my letters to the owners.

e. I think most experienced mining engineers would be of opinion that a hill (less than two miles from a railroad depot) which was "almost a solid body of Millerite, Nickeliferous, Pyrrhotite and Chalcopyrite, all of a high grade" could be developed and made to pay its way, "from the grass roots downward" with a commencing capital of considerably less than $700.

f. When Mr. Ahn says I "descend to the gutter" in my article, I do not understand him. I am, however, willing to admit that in spite of his apparently slender acquaintance with mining matters, he may be a profound authority upon all questions of the gutter ; and so I will not attempt to meet him in that particular field of discussion.

Yours, etc.,

STEPHEN H. EMMENS.

The Mining, Manufacture, and uses of Asbestos.*

By Mr. J. A. Fisher, Manager United Asbestos Co., Londonderry.

It would be impossible to give, within the limits of a paper of this description, more than a brief outline of the history of the mining and manufacture of asbestos. Moreover, the time at my disposal—since I had the honor of receiving an invitation to read to you a paper on this subject—has not been sufficient to enable me to collect and arrange the materials on which it is based in the order I could have desired ; nevertheless, I hope to lay before you some particulars which may be found interesting. Asbestos has been found in all quarters of the globe, and there is, at the offices of the company with which I am connected, a large collection of interesting specimens, which I should be pleased to show to any gentleman who cares to call and see them. They come from Italy, Canada, Newfoundland, the United States, Southern and Central America, China, Japan, Australia, Spain, Portugal, Hungary, Germany, Russia, the Cape, and Central Africa. Scarcely a week passes without some new specimen arriving or an opinion being sought on some new discovery of the mineral substance.

Nearly all the discoveries made up to the present time have proved of little value, although we frequently see in the newspapers announcements of new sources of supply of so-called fine qualities of asbestos fibre, which, on investigation, prove to be worthless to the manufacturer. The important difference between good and bad asbestos will be at once perceived by an examination of the few specimens here, and I may say that the only kinds hitherto found suitable for commercial purposes are the Italian and Canadian varieties. These possess the properties of infusibility, tensile strength, fineness and elasticity which are so essential to manufacturers and the users of asbestos. It will be observed that this specimen of Australian asbestos, about the discovery of which a great deal was made in the papers some time ago, is very brittle and quite worthless for spinning or weaving purposes. I have here, also, a specimen of African asbestos. It is dark blue in colour, and while the length of the fibre is about the same as the Canadian, it is altogether wanting in fire-resisting power. Last year a considerable quantity of asbestos somewhat resembling the Canadian in character and formation was imported into this country from beyond the Ural mountains in East Russia, and we thought it would be worth while to make somewhat extensive experiments with it. As the result was not satisfactory I need not say anything more about it, but confine my further observations to the mining and manufacture of the two kinds of proved value, viz., Italian and Canadian. Specimens of these in the raw state, just as received from the mines, also after being cleaned and carded, are before me. The Italian variety may be distinguished by its longer fibre, saponaceous nature (an important quality when used in contact with moving parts of machinery), and its brown and greyish tint, while the Canadian is shorter, less saponaceous and white in color. Each kind has special merits, and is used for the purposes which experience has proved it to be best adapted.

I will refer first to the mining of Italian asbestos. The modern history of Italian asbestos mining may be considered to commence with the present century. We find that about ninety years ago two enterprising citizens of North Italy conceived the idea that what had been done in ancient times might be undertaken for modern requirements, and that a cloth made of this material would answer well for various purposes. They carried out some experiments in Lombardy, which were considered to be, to a certain extent, satisfactory ; but the numerous crises which kept this part of Europe in a perpetual state of disquietude prevented the development of the trials, and for a further space of years asbestos seems to have been looked upon as a substance of some interest to the mineralogist and geologist, but of little or no practical and commercial value. It was not until the year 1866 that Signor Albonico, having given some attention to this product of the mountains of his native province, got into communication with a highly cultured and intelligent Florentine cleric, Canon del Corana, and they were subsequently joinedby a distinguished Roman nobleman, the Marquis di Baviera. The result of their endeavors was that they produced some asbestos cloth and paper, and were in hopes of obtaining a contract from the Italian government for the supply of the latter for bank notes and other securities, but failed in this, and whatever prospects they may have had of better success in other directions

*Abstract of a paper read before the Institute of Marine Engineers

were spoiled by the outbreak of the Franco-German War of 1870. Signor Albonico had, however, obtained concessions from several communes of the right to work this material on their respective properties.

The valleys and mountains amongst which asbestos is found, although little known to the average tourist, are amongst the most beautiful of those which form the Alpine region, and the scientific man could not desire to explore ground of greater interest. As I am only concerned at present in describing those districts in Italy in which asbestos of commercial value is obtained, my remarks will be confined to those under the control of the company already referred to as that I am connected with, which holds all the mines of any real value, it may therefore be taken that my description will leave none unnoticed.

The first district in which asbestos of commercial value is obtained to which I desire to call your attention is the Susa Valley, which is approached from France through the famous Mont Cenis Tunnel. On emerging from the tunnel on the Italian side, the line follows the southern mountain slope, with a gradual descent, overlooking the town of Susa, which gives its name to the valley, and which is placed at the head of the plain, which at times widening, and at times narrowing, for a distance of about forty miles, finally opens out on the great plain of Piedmont. At a point in the centre of the valley, and on the northern mountain slope, are the places from which the floss asbestos fibre, the appearance of which in gas stoves is familiar to us all, is obtained. In the same locality is also found a fine white powder of asbestos, used in asbestos paint, and for other purposes. The ground from which these materials are got is about ten square miles in extent, and the works are carried on at a height of from 6,000 to 10,000 feet above sea level. The first temperature is, of course, low at such an elevation, but the inhabitants are hardy and robust, and make willing miners. The works are reached by mule-paths for some distance, but the remainder of the way has to be done on foot, and from four to five hours are required for the journey from the plain, on which are the railway and high road. The first work done here in recent times dates from 1876. The mode in which the material is brought down the mountain side is by loading it on a sort of toboggan or sledge, which slides as easily over the rocks as over snow, and so expert are the inhabitants at this work, that two men can bring down 1 cwt. of asbestos in three hours.

The second of the districts to which I will refer is the Aosta valley, commencing at Ivrea, a town of some importance, about forty miles, in a nearly northern direction, from Turin. From Ivrea to Chatillon, a distance of a little under 30 miles, the railway passes through the heart of the asbestos properties which flank it on either side, the direction being north-westerly, and at the latter town (Chatillon), the valley trends sharply to the west, until the city of Aosta, the ancient Augusta, is reached. The history of the asbestos mining industry in this province is as follows: In the year 1849 Signor Antonio Ré, of Rome, finding himself implicated in certain political troubles, took refuge in this valley, where he lived for many years. In 1873 he became aware of the proceedings of the Marquis di Baviera and the Priest Corona, and set to work to investigate the question of asbestos in the Aosta valley. He, like others, was aware of its existence, but until then the mineral found in this district had been thought of inferior quality, and not serviceable for any industrial purpose, so that no trouble was taken about it. In the year named, however, Signor Ré undertook a search for some better qualities, and having assured himself that such could be found in abundance, he put himself in communication with the gentlemen I have mentioned, and they being satisfied with the material, started working on a pretty large scale.

It is impossible to give, with any degree of exactitude, the extent of the ground covering the asbestos mines in the Aosta valley, as it has not yet been all thoroughly surveyed; but as the valley is some seventy-five miles in length, and varies in width from five to forty miles, some idea may be formed of it. Notwithstanding the large quantity of asbestos that has been got, enormous deposits remain untouched, and the yield may almost be considered inexhaustible. The quality of asbestos in the Aotsa Valley is not, however, similar to that in the Susa Valley. It is of the kind known as "gray fibre," long, strong, and soapy to the touch, and is similar to that obtained in the third and perhaps most important of the vast areas which is situated in that portion of Lombardy known as the Valtellina. The district is divided into five communes, and the asbestos properties have an area of about 25,000 acres, or nearly forty square miles. The population numbers about 5,000, of whom a large proportion are engaged in asbestos mining. Throughout the whole of this extensive area the mineral is found in abundance and of the finest quality. For a distance of eleven miles of the twenty, which form the length of the Val Malenco, the name given to the valley in which the asbestos most plentifully abounds, there is a good carriage road, but beyond that the ascent to the mines is by following mere goat-tracks, and as the slope of the mountains is steep, the labour of bringing the mineral to the road in the bottom of the valley is very great. The surface of the ground is, for about one-third of its extent, pasture and woodland, the remainder being bare rock, which admits of easy examination and trial. A great portion of these mountains is as yet unexplored, but indications have been observed which lead to the conclusion that the supply of asbestos is practically inexhaustible. The height above sea-level of the mines hitherto opened out varies from 3,600 to 7,200 feet. The climate, is for such an elevation, comparatively mild, there being some places at a height of 6,000 ft. where work can be carried on during the whole year. The inhabitants work willingly at the asbestos mines, in spite of its not being unattended by danger from landslips and avalanches.

For a long time the opinion was held that at a certain depth, greater or less according to circumstances, the veins of asbestos gradually lost themselves in the serpentine rock, but recent experience has proved the fact that if the direction of the vein he followed it will be again met with. The work is carried on by means of shafts and galleries, dynamite being used for blasting purposes. We also find the fibre at the greatest depths of better quality, being less indurated than that nearer the surface.

I come now to the mining of Canadian asbestos, and in dealing with this part of my subject, although I have visited all the principal asbestos mines in Canada, and studied the subject of asbestos mining in that part of the world as well as in Italy, I shall avail myself in the few remarks I may have to make of the researches of Dr. Ells, of the Geological Survey of Canada, whom I have the pleasure of knowing. Dr. Ells and other Canadian authorities state that the mineral asbestos proper—the Italian variety—belongs to the hornblende group of minerals, while that which is produced in Canada at the present day under the head of asbestos is in reality not asbestos proper but a serpentine rock called chrysotile. This occurs in veins in certain portions of the great belt of serpentine rocks of the eastern townships of Quebec, especially in portions of the townships of Thetford, Ireland, Coleraine, and Wolfetown. It is stated in the *Canadian Mining Manual* for 1891 that although asbestos was known at many points in Eastern Quebec more than thirty years ago, and was exhibited at the international exhibition in London in 1862, no attempt was made to work the mineral for some years. The credit of the discovery of the Thetford area is probably due to a French-Canadian named Fecteau, and following up his discovery certain areas were secured from the government by private parties. The value of the mineral was not at first recognised, and in the first year of mining operations, 1878, only fifty tons were taken out, for which a ready sale was not at first obtained.

The publication of the prospectus of the United Asbestos Company in the year 1880, referred to further on, gave a great impetus to asbestos mining enterprises, and new companies obtained tracts of rocky land in the townships of Thetford and Coleraine, and began the work of exploration and mining, the result being that from the year 1884 to the present time, large and increasing quantities of asbestos have been exported from Canada, a large proportion of which, however, would be of the qualities known as second and third grades, and used largely in the United States for covering steam boilers and pipes, roofing, building, and other purposes. Although Asbestos mining and prospecting in Canada has continued for fourteen years, and the areas of serpentine are very extensive, the portions in which asbestos of good quality or in paying quantities is found, are in comparison so small that mining operations are practicaliy confined to two centres only a short distance apart. These places may be reached in a few hours from the city of Quebec by train on the Quebec Central Railway, which runs through the heart of the asbestos mining district at Thetford and Black Lake stations, about midway between Quebec and Sherbrooke, at which point train may be taken to Montreal or the South.

Dr. Ells points out, and this is confirmed by my own observations, that the rock carrying the marketable asbestos is generally a serpentine of some shade of green on fresh fracture, usually a greyish green, in which are contained numerous small particles of iron, both magnetic and chromic, more usually the former. Serpentines that have a black, hard, chippy aspect do not promise well. In the asbestos-bearing rock proper the veins of asbestos are seen, without any special arrangement, intersecting the mass of the rock generally in every direction. In size they range from mere threads, sometimes close together, as in the specimen here, to a thickness of one to two inches, and, vary occasionally, three to four inches. The asbestos from these larger-sized veins, provided it contains no serious impurities, is classed as grade No. 1, and is used for spinning and weaving; the shorter stuff and such as contains impurities, is classed as No. 2 and No. 3 respectively. These latter grades, as I have already pointed out, are used principally in the United States for millboard, boiler and pipe covering and other purposes. The character of the ground, and the nature of the operation of mining, or more correctly quarrying, asbestos in Canada, may be ascertained from the plan and photographs I have here of our mines at Black Lake. Hand labor, which we are obliged to employ in Italy, owing to the difficult nature of the ground, has been largely superseded in Canada by the use of steam derricks, drills worked by compressed air, and other appliances. When a block of asbestos-bearing rock has been displaced by the usual methods employed in blasting, the pieces are broken up, barren rock removed to dumps or waste heaps, and the remainder passed through the process of cobbing, whereby the remaining rock is removed, and the asbestos exported in the form in which you see it here, and ready for the manufacturer.

The third part of my subject deals with the manufacture and uses of asbestos, and here I suppose we must give the ancient Greeks and Romans the credit of having been the first to make asbestos cloth; but there is nothing on record to prove that it was made or used on what we should term a commercial scale. There is in the Vatican an interesting specimen of asbestos cloth which is said to have been preserved from ancient times, and Marco Polo mentioned, in the account of his travels in China in the thirteenth century, a fire-resisting cloth, which he at first supposed to be made from the skin of the salamander, but which proved to be asbestos.

I have already referred to the part which the Italian priest, Corona, took in connection with the exploration and opening up of the Italian asbestos mines in 1866. A Mr. Richard Lloyd took out a patent in the United States in the year 1857, for a packing in which he claimed the use of asbestos, but I am not aware that this packing ever came into practical use, so that, so far as our information goes, the priest, Corona, has the credit of being the person who in modern times first explored for the raw Italian asbestos, and then successfully produced from it a millboard which has become such an important article of trade, though its composition and its manufacture have undergone many changes and improvements since Corona's time. I believe that asbestos was used in the United States in the year 1868 or 1869, in connection with the manufacture of roofing felt and cement, but it was reserved for some enterprising Scotchman to first bring asbestos to the notice of engineers in this country. In this connection I should not omit the names of Mr. H. R. Robson, of Glasgow, and the late Mr. Walter McLellan, of the well-known Glasgow engineering firm. These gentlemen (with whom I was afterwards for several years associated in connection with the asbestos industry), having satisfied themselves as to the commercial value of asbestos, formed a company in the year 1871, called the Patent Asbestos Manufacture Company, established a work in Drummond Street, Glasgow, and commenced operations. I have already shown you how about this time the priest Corona, the Marquis di Baviera, Signor Albonico (the present manager of Italian mines), and Messrs. Furse Brothers, of Rome, were actively engaged in securing properties and concessions to work asbestos from the communal authorities in Italy, and when a few years later another company called the Italo-English Pure Asbestos Company, London, came into existence, backed by powerful influence, secured extensive mining rights and established a manufactory in Turin, keen competition for supremacy commenced. The result was that all these companies were amalgamated in the year 1880, by the formation of the United Asbestos Company, under the presidency of Sir James Allport, of the Midland Railway.

Competitors were soon in the field, and obtained a share of the trade opened up by the enterprise of the pioneer company. It was found desirable to concentrate the manufacture hitherto carried on at the old works in Glasglow, Turin, and Tivoli, near Rome, and extensive works were secured for this purpose at Harefield, near London, where asbestos goods, in all the forms in which they are offered to engineers to-day, are manufactured. The machinery and plant for this purpose is of the most complete description and would occupy far more time to describe than is at my disposal. I will briefly state the process of manufacture, and in doing this will refer mainly to the Canadian asbestos. The Italian fibre is more difficult to deal with, and requires special machinery. As we have recently effected further improvements in our mode of treatment, you will understand my reasons for a little reserve on this part of my subject.

Our works are divided into several departments. First there is the sorting and opening department, where the crude asbestos is dealt with. The blocks of fibre or "rock," as seen here, are crushed and opened up in special machines in such a way as not to destroy the fibre, and are passed thence to "shaking" machines, where the long fibre is separated from the short, and particles of rock removed. The long fibre suitable for spinning into thread is then taken into the carding and condensing department, and the short to the millboard and boiler covering departments. The treatment of the long fibre in the carding and condensing department is very similar to that in a textile factory, but its appearance would be scarcely encouraging to one who had been accustomed to wool or cotton. These latter staples, examined under the microscope, exhibit a notched or serrated appearance, which explains the ready way the material clings together when twisted. The peculiar nature of asbestos presents difficulties which are rendered more evident when its behaviour in the machines is watched, but these difficulties are overcome by special appliances attached to the condensing machines. As the fibre comes from the condensers in the form of silver or condensed thread without any twist, it lightly folds itself in cans placed there to receive it, and is then taken to the spinning and doubling department, where it is twisted into threads of every degree of fineness required. The thread then passes to the weaving and braiding department, where it is made into various forms of yarn packings, also into tapes and cloth. The cloth is then taken to the indiarubber department, where it is proofed and made into what is known as asbestos and indiarubber woven sheeting, tape and rings for steam and other joints, and also into rolled cloth and square block packings for glands.

This brings me to an important matter to which I should like to direct your particular attention. Recognizing that in these days of fast steaming and high pressures it is of supreme importance to marine engineers that they should have jointing and packing materials upon which they might place reliance, we produced six or seven years ago a combination of asbestos and metallic wire, which, with further improvements, recently effected, fully answers our expectations. Attempts had been previously made in this direction, but the results were not considered satisfactory, inasmuch as the asbestos metallic cloth to which

I refer was simply woven either with a wire warp and asbestos weft, or with alternate threads of asbestos and wire. We enclose, by an improved method recently adopted, a fine brass wire in the centre of every thread of asbestos in both warp and weft, thereby adding very largely to the strength of the cloth, while the wires are completely protected by the asbestos. This material is known as the Victor metallic cloth, and, being made into tapes and all sizes and shapes of joints as well as into round and square packages, is now largely used with satisfactory results by marine engineers and others. So dense and close can we now make joints from this material that it is being largely supplied for hydraulic work, and I have here two small rings which have been tested up to pressures of 2,500 and 3,500 lb. to the square inch respectively.

Another form of joint to which I should like to direct attention is the Salamander joint recently patented. These joints have two concentric rings made from the metallic cloth to which I have just referred. The rings are sustained by a suitable metal ring, the vertical wall in the centre of which forms a partition between them, and absolutely prevents the possibility of displacement by either steam or moisture. By this arrangement, in fact, a double self-sustaining joint is made in place of the ordinary one. There is great diversity of opinion as to the utility of Indiarubber cores in gland packings. If the cores are properly made, and are of the right quality of rubber, there may be a good deal to be said in their favor, but my opinion is that the use of inferior rubber is detrimental to the packing. Metallic cores are being tried, but I cannot see the use of a core at all unless it has some degree of elasticity. None of those I have seen contain this quality; some are practically solid, and others collapse completely under pressure. I have been making experiments lately in this direction, and have so far succeeded as to lead me to hope that I may shortly be able to submit an elastic metallic core packing to the practical judgment of marine engineers.

Turning again to the processes of manufacture at Harefield, I said that in the sorting and opening department the long fibre suitable for spinning is separated from the shorter fibre suitable for millboard and boiler covering, and this brings me to the millboard department. The manufacture of asbestos millboard is somewhat similar to that of ordinary cardboard. After some preliminary treatment, the asbestos fibre is run with water into the tanks of beating engines. Each of these tanks is provided with a rotating beater, which maintains a thorough circulation, taking up the fibre, opening and drawing it out, and then sending it forward to be soaked for a time until it comes round again to the beater. The binding ingredients are here added and thoroughly mixed with the fibre, when the pulp is passed into the vat of the millboard or paper machine, where it is kept in a state of agitation until gradually drawn off. The water passes through a fine wire gauze on a revolving cylinder, leaving a thin coating of pulp on the cylinder. This is then transferred by means of an endless band to a second rotating cylinder, where it gradually accumulates until the desired thickness has been reached. It is finally cut across and removed in the form of a square sheet of millboard. As the sheets contain a large percentage of moisture, they are next placed between sheets of zinc and passed under hydraulic pressure, and then hung in drying rooms. They are then again pressed and their edges trimmed, when their manufacture is complete.

In this process the chemical composition of the asbestos undergoes little if any change, and excepting the binding materials which have been added, chemical analysis shows the composition of the best millboards to be practically the same as the fibre from which they are made. It will be observed that nothing would be easier than to adulterate millboard pulp while in the beating engines, and large quantities of china clay and other ingredients are used by some manufacturers in this process. It has the effect not only of increasing the weight, but also reducing the cost, to the detriment, however, of the finished material. I should not like to say how far the practice prevails in this countrv, but of one thing I am certain, it is not done at the works of the United Asbestos Company. I have here a specimen of our special A1 quality of Italian asbestos millboard.

I now come to the boiler covering department, where the short fibre and powdery asbestos is worked up with other suitable ingredients into a non-conducting composition for covering steam boilers and pipes. Great improvements have been effected in this composition in recent years. The use of asbestos for this purpose has been criticised in some quarters lately, where it was desired to supersede it with other materials, and an attempt was made to show that asbestos was after all a bad non-conductor of heat. Now, after years of study of this subject, I may perhaps be allowed to say that much depends, firstly, upon the kind of asbestos used, and, secondly, upon the composition of the ingredients used with it for lightening it and for binding purposes. I venture to assert that with proper manipulation and application, asbestos composition will compare favorably with any other material as regards its power as a non-conductor of heat, while its indestructible nature is certainly a point worth consideration. The subject of covering steam boilers and pipes has, however, been brought into special prominence by the rule of the Board of Trade that all steam pipes and boilers of marine engines shall be tested by hydraulic pressure to double the working pressure at certain intervals. Before testing the pipes the lagging must be removed, but it is, I believe, in the discretion of the Board of trade surveyor whether or not the lagging of the boilers shall also be removed before testing.

This rule points to the desirability of producing a satisfactory removable boiler and pipe covering. The idea of making quilts or mattresses composed of asbestos cloth filled or stuffed with non-conducting material is not new, for this was done by us years ago for non-conducting purposes. But the way in which these quilts or mattresses were prepared was somewhat defective, as the fibre or other material with which they were filled shifted its position, the result being that some parts of the mattress became choked and other parts empty. This defect has now been removed by a simple arrangement which we have protected, and I have pleasure in showing you samples of this covering, which I hope will satisfactorily meet the requirements. The weight of the covering is only 1½ lb. to the square foot; it is easily applied, and may be removed and replaced without trouble. It has been carefully tested as a non-conductor, and found to give excellent results. We have already supplied several mattresses of this class to shipbuilders in this country. The surface can either be painted like the specimens submitted, or they can be covered with sheets of zinc. The latter has been done in some of the cases to which I have referred.

I may here allude to the asbesto paint, in which a considerable quantity of asbestos powder is used. These paints were patented by us and introduced in November, 1881, and are of two principal kinds: asbestos fireproof paint, suitable for rough woodwork such as joists, rafters, beams, stairs, warehouses, and wooden structures of all kinds, respecting which numerous public experiments have been carried out from time to time, to prove its remarkable fire-resisting qualities, and the asbestos oil paints, which are fire and acid resisting, but not quite fireproof. One special kind, however, will be of interest to marine engineers, viz., asbestos funnel paint. It resists great heat, as well as the action of sea water. When first introduced in an experimental stage, it proved less satisfactory than could have been desired, but the difficulties have now been overcome, and its use is steadily increasing.

Will you bear with me while I refer to one other matter which I think will interest you? I refer to bunker fires. You may remember that Professor Lewes read a paper before the British Association in August last on the "Spontaneous Ignition of Coal." In the course of his remarks he said that bunker fires, which were becoming very frequent on some of the fast liners, were due entirely to rise of temperature from the bunkers bulkheads being too close to the hot-air upcast shafts from the boilers and furnaces, and he said that he thought the necessary safety could be obtained by having a thin water jacket between the smokeshaft and the bunkers. Now, it happens that a day or two before I was invited to prepare this paper, I had written a letter to the editors of several technical papers on this subject venturing to express an opinion that many practical difficulties would arise in connection with the fitting of efficient water jackets, and pointing out that the necessary safety might be economically obtained by a proper application of asbestos to the uptakes, funnels and bunkers. I pointed out that this would not occupy more space than is usually occupied by the air casings or baffle plates which are generally fitted to these parts, and that it could be applied to any existing steamer (as it has in fact been already applied for the purposes of my experiments) without any alterations being made or room being specially provided. With asbestos on the uptakes and funnels to keep the heat in, and on the bunkers to keep it out, and with ordinary ventilation of the space between the two, all risk of fire would be removed. I shall be pleased to go more fully into this matter with any gentleman who takes an interest in the subject.

If I were to refer to the numerous other articles into which asbestos is manufactured, I should only weary you. Twelve years ago only three or four distinct kinds of goods were made; now we turn out over a hundred varieties. Asbestos twenty-five years ago was practically only known in the laboratory of the chemist or mineralogist. It now finds its way in one form or another into almost every workshop where steam is employed. I am being constantly asked to advise as to its suitability for a variety of operations, and it seems likely that its use will continue to extend.

Mining in British Columbia in 1892.

(By C. F. Law, B C., World's Fair Commissioner.)

In looking back over the year 1892, we are pleased to note a great advance over the preceding year in all that pertains to the development of the mines of this Province. The era of active quartz mining appears to have dawned at last, and as the field of such activity is neither local nor restricted, we may reasonably hope that the coming year will see new sources of revenue added to those which already form the basis of our wealth. We propose to report on the general advance which has taken place throughout the Province in mining industry by noting first what changes have occurred in the oldest of our mining districts, viz., Cariboo, and while we cannot discover any increase in the production of gold from placers or quartz in that country, a state of affairs exists which will within a year or two, at the most, make a notable change. The district has long been an interesting study to those who look for a quartz development to supersede the worked out placers which proved so rich in the earlier history of mining in this Province. In all of the gold bearing countries to the south of us and in Australia, the placers after being worked out, led to a great quartz era, and we may certainly expect that, although so long delayed, this will take place sooner or later. Cariboo has some drawbacks which other gold countries have not suffered from, but these cannot be said to be insurmountable, although they are of a character to keep capital in more accessible places. We refer chiefly to the lack of railroad communication. The construction of the Canada Western would produce a very remarkable change, because it would open that portion of the district which is at present most inaccessible and would lead to the opening of a country, known as the great bend of the Fraser, which is rich in gold and only waits cheap transportation to attract a large population.

With the new importance given to gold by reason of the single standard being maintained and the consequent decline in silver, we think a great impetus will be given to mining in Cariboo in the near future. Those quartz properties which have been opened already present some good features which make them worthy the attention of capital. The Island Mountain Mine, B. C. Milling & Mining Co's property and the Black Jack properties only require more capital and cheaper labor to be made productive. There are other prospects which have still greater attractions, but as there is a more extended field for investigation, only a very small section of the country has been prospected for quartz, whereas the whole district is worthy of close attention. It is possible that a zone of auriferous quartz may be found, as in California, to be outside of the placer area. If a mother lode exists it has yet to be discovered, but a key to this may be found in looking for similar conditions to those which prevail along the course of the best known gold quartz belts of other countries. In the vicinity of Hixon Creek some rich ore has been found in irregular pockets and stringers, in a dyke of so-called porphyry which lies between slate and granite, having Dioritic rocks in intruding the slates.

It is possible that a good pay zone may be found along the contact of the slate and granite in that portion of the slate which has become metamorphosed where it approaches the granite.

This belt should be prospected from Hixon Creek to Cariboo proper, as it is where Diorites intrude that rich ore bodies may be discovered similar to those in California.

A very favorable locality for the discovery of gold quartz is the ridge which lies between the North and South Forks of Quesnelle River. An effort will be made to look this ground over next season.

The Forks of Quesnelle River enjoy the distinction, at present, of attracting more attention than any other portion of Cariboo.

The Victoria Hydraulic Company has completed a ditch 12 miles long, five feet on the bottom, seven feet on top and two feet deep from Spanish Creek to North and South Fork. They have one mile of iron pipe to connect with the ditch. It is expected that work will begin early in the spring and a clean-up made next season. The South Fork Company have eight miles of ditch completed, four feet at bottom and twenty inches deep. They have some difficulties to overcome before getting into the old channel which is known to run through the ground, but when this is opened a very heavy production of gold may be looked for. It is to hydraulic mining in this vicinity and Horsefly River that we must look for the first solid advance in Cariboo mining. Taking a careful review of the whole situation as it now stands in Cariboo, there is no investment which promises so well as the consolidation of these various hydraulic properties, with large capital, in the vicinity of Quesnelle Forks.

Too limited capital has caused the failure or retarded the success of more than one great enterprise, and we think money can be nowhere so well employed as in opening hydraulic properties of known value, on the largest scale. If this is done we have reason to hope that the advantage gained will be maintained by the discovery of gold quartz veins which will pay for their exploration and development after hydraulic mining in the district has proved a great success and encouraged capital to make further ventures.

There is a vast country lying between the North Thompson and great bend of the Fraser, which is practically unknown and invites the attention of those prospectors whose ambition it is to explore where no one has yet travelled. Bowman says in his report, that "the Cariboo range, forming the north-eastern limit of the Cariboo country, is the north-westerly continuation of the Selkirk range. The crystalline schist, or gold belt, seen on Quesnelle Lake, is represented by similar rocks on Shuswap Lake and in Eagle Pass." Here is a key for the prospector to work upon and should be closely followed up.

In reviewing the work done in Yale district during the past year, we are compelled to note the preponderance of the economic orcs over the precious minerals so far discovered in that section.

We dare affirm, with every prospect of near fulfilment, that Kamloops is destined to become the industrial centre of the Province. Nowhere else has nature been so lavish in her riches in a situation where they can be so easily and profitably utilized as in this section.

The very best quality of iron yet discovered in the Province is found here in close proximity to the track, with a coal field of magnificent proportions to draw from, for its reduction and manufacture into commercial iron and steel.

The Kamloops Coal Company, on the North Thompson, have 1,800 acres of coal lands upon which they have twelve men employed.

The principal vein is 38 inches wide, of clean coal, supplemented by another of four feet which appears to converge towards it. A test made gives 62. fuel carbon with 70 per cent. coking quality.

The Canada Pacific are now making a locomotive test with good results. The Coal Hill Kamloops Mineral and Mining Company, whose property is situated two and a half miles south of the town, near Guerni's ranch, have a similar property in which they have run a drift 110 feet, under the superintendence of Major Vaughan. The coal is a first-class article. In Nicola another company is also opening up veins of coal, which we hope will prove equally good. A very fine quality of cinnibar ore is found on Copper Creek, and should invite the attention of capital at once, as the working out of the New Alameda mines in California, has made the ore of mercury a valuable commodity. Large finds of mica have been made at the head of the Thompson, but these veins are very inaccessible at present ; of more importance for the immediate purpose is the discovery and opening up of very good silver-lead properties at Mosquito Flats on the North Thompson River.

Messrs. Wood and Tunstall, of Kamloops, have bonded the Lone Prospector claim to American capital upon most liberal terms, but which have regard to that most important consideration, viz., the development of the property.

On Siwash Creek good ores have been discovered which will be heard from next season.

The Vancouver Hydraulic Co's work on Van Winkle Bar, opposite Lytton, promises to be an important factor in the resources of this district. The bold and aggressive work inaugurated under the superintendence of Jacob Holland and by the advice of so well known a hydraulic expert as Mr. Hobson, is proof of the enterprise of Capt. Tatlow and his associates. A pipe of 3,000 feet in length, varying from 16 to 18 inches, has been laid down to conduct the water under a pressure of 377 feet.

The bar is three miles in length and half a mile wide, with three benches, prospecting from a few cents to one dollar per cubic yard. The facility with which sluicing can be carried on at all seasons and free escape for the tailings make the working of the ground most economical, and we look for great results. Application has been made by Kamloops parties for leases on Tranquille Creek, opposite to the ground which Chinamen have made pay for so many years. A good head of water can be obtained for hydraulic purposes, and next season will witness a change about Tranquille.

In the Westminster district very active prospecting has been done by the Anglo-American Mining Co. at Douglas, Harrison Lake.

Mr. Tallyard reports many good finds of gold and silver ores, but does not wish to advertise the country until developments prove a success. In the Similkameen district some prospecting has been done at the head of Wolfe Creek and discovery made of peacock copper. This whole district has been sadly neglected, but its turn will come when other places have become overdone.

The Hydraulic company operating on the Tullameen River is actively negotiating at the present with English capital, with a view to sale. Increased capital will bring this property into a prominent place. In Okanagan district very little mining is being done, the country being largely devoted to pastoral pursuits.

There exists, however, one property which is most worthy of mention, viz., the Monashee mine, at the headwaters of Cherry Creek. The property has been developed in a most miner-like manner by McDonald McIntyre, one of the owners, and only needs the introduction of capital and mining machinery suited to the reduction of gold ore, which is in part free but where principal value will be found in the concenttates. The ore runs in assay value over $20 to the ton in gold, one quarter of which is free. The veins have been well exposed by tunnels at various levels, and the situation of the mine is first-class. The district of Osoyoos has come to the front in a very remarkable way during the past year as a gold producer. The principal camp is about Fairview, in the vicinity of Rock Creek, and embraces the well known claims Ratler, Brown Bear, Silver Star and Wym, acquired by Geo. Atwood and E. D. Reynolds for the Stratheyre Mining Co. These properties were paid for in spot cash, and the direct amount of money transferred in payment for same exceeds any deal hitherto made in the interior of the province. Other very valuable claims exist, among them being the Silver Crown, owned by Messrs. Andrews & Fleming, of Seattle, and Stemwinder, Morning Star, Black Diamond, Wild West, claims by various parties.

Camp McKinney, also in the same district, has a good property in the Eureka claim, which is being operated by the Douglas Mining Co., other important claims being Carbonate and Cariboo locations.

Boundary Creek has some remarkably good prospects, which have been opened up by Mr. Atwood and the Spokane & Great Northern Mining Co. Trial shipments of ore have already been made and proved very high grade. Many varieties of both silver and gold ore occur in this district, the Mineral King and Mountain Chief being free milling ores.

Kettle River and Priest Lake have added to the known wealth of the district, and we look for a large development next year. The district of Osoyoos, like West Kootenay, is very easy of approach from the other side of the line and offers great inducements to prospectors, who find their field of operations too circumscribed south of the 49th parallel. The first continuous supply of gold bullion produced from quartz mined in this province promises to come from Osoyoos, which is no mean distinction. Trail Creek is advancing steadily in the same direction.

The ores from this camp contain as high as 7 per cent. copper, but gold is the principal value. Several very important properties are mentioned as promising to make big mines, viz : the Le Roi, Centre Star & I. X. L., O. K., Standard, Yellow Jacket, Josie, etc.

The Le Roi and Centre Star have been opened by tunnels over 200 feet long, and the development of the entire camp has been of the very best character. The future of Trail Creek is assured, and as wagon road connection is now had with Northport, on the Spokane Northern Railway, it is easy of access, which is no unimportant factor in the opening of a camp.

A very promising gold find was made on Salmon River late last summer, which gives high average returns in free gold. The country, a small amount of placer gold, has attracted the attention of Nelson men as a possible gold quartz field. On Toad mountain and in the district of Nelson no new discoveries have been made, but as it already has such properties as the Silver King, Dandy, Iroquois, Goldendale, Poorman, Whitewater and others, upon which a vast amount of work has been done, it is not necessary that new discoveries should be made in order to insure the success of the district.

So far as yet known the Silver King is without a peer, and when the hope which has been deferred so long is at last realized, this camp will at last take its proper place as a great mining centre. At Pilot Bay we have evidence of the enterprise of a gentleman who has done much for West Kootenay. Dr. Hendryx has made for himself the proud record of furnishing the Kootenay Lake district with the first smelter, which makes it possible to reduce the ores of the district into refined bullion. Mr. Farrell, who is associated with Dr. Hendryx, must be well pleased when he considers the great field which has been opened up by the discovery of Slocan and Lardeau.

The Blue Bell mine ore can now be mixed with the other ores of the district and a continual supply furnished without fear of interruption. The Pilot Bay smelter will cost when completed $300,000.

The wharves constructed are of a very permanent character, and extend for a distance of 900 feet.

The office building contains nine rooms and is fitted with fire-proof vaults.

An assay office, 25x50 feet, with a wing, 25x25, has been completed. These are brick and iron, and are very substantial.

In addition to above are a warehouse, 35x65 ; blacksmith shop, 24x40 ; carpenter shop, 24x50 ; boiler house, 48x50 ; smelter building, 60x98 ; sampling works, 98x128 ; calcining furnaces in a building 98x170, boarding house, three stories and basement, accommodation for 100 men, refinery building, 120x245, all brick made in three drying houses, 36x50 each.

The Ainsworth camp is making fair progress, and will be heard from when the others get down to solid production.

A number of deals in properties have taken place, but the camp has suffered to some extent by the overshadowing influence of Slocan.

Development work has been proceeded with throughout the season, notably in Centre Star, where Mr. G. B. Wright has had eleven men employed driving a tunnel. The No. 1 and United are quiet. The Neosha has been continuously represented, and the Krao, Sky Line, Little Donald, Spokane, Tiger, Lady of the Lake, Mamie, Sultan, Bunker, Fourth, Eden and Crescent, Glengarry, Tam O'Shanter, Kootenay Chief, Tenderfoot, Tariff, Libby, Highlander and others are still to the fore with excellent prospects for the future. We understand that the Sky Line will be worked this winter on a large scale.

The history of the discovery and subsequent opening of Slocan district is most absorbing to those who watch the march of events in this province. To give an extended report of the wonderful transformation which has taken place since we wrote on this subject a year ago, is to repeat an oft told tale, but one which cannot fail to be of interest to the general public.

Although less than a year has elapsed since the first transfer of mining property in Slocan was placed on record, $220,934 in cold cash has been paid for mineral claims situate in the district.

There are now 750 locations on record in the office at New Denver. Assessment work has been performed on 120 locations, only twenty-five claims being abandoned. The records show that 300 bills of sale, agreements and contracts have been recorded, and that $554,500 is still due on sales and bonds.

In most cases large prices have been paid and the following are some of the largest transactions : Two-third interest in the Reco group, $50,000 ; Twin Lake group, $40,000 ; Stormont group, $6,000 ; Jardine group, $75,000 ; Ruby Silver, $25,000 ; Idaho, $20,000 ; half interest in the California, $8,000 ; one-third interest in the Best, $10,000 ; Last Chance, $10,000 ; Slocan Star group, $25,000 ; Freddy Lee, $20,000 ; Blue Bird, $25,000 ; Lucky Jim, $10,000 ; Great Western, $15,000; Washington, five-twelfth interest, $8,000 ; Washington, one-fourth interest, $8,500 ; Washington, one-fourth interest, $22,000 ; Dardanelles, nine-sixteenth interest, $56-000 ; Mountain Chief, $15,000 ; Montezuma, $25,000. The lowest of these is $8,000, and there are also a number of other sales recorded under $5,000 and downwards. The total amount of the transactions reaches the immense sum of $700,000, and an idea of the increased confidence in the mines can be seen from the different sales of portions of the Washington, a quarter interest having been sold for $8,500, while shortly after another quarter interest was sold for no less than $22,000.

Assays show a range from 100 oz. to 2,000 oz. per ton, averaging nearly 200. A 10-ton shipment from the Dardanelles averaged 500 oz. per ton : Freddy Lee shipments, from 100 to 200 oz. The producing mines being worked this winter are the Young Dominion, Freddy Lee, Washington, Best, Idaho, Blue Bird, Cumberland, Mountain Chief, Mountain Boomer, Dardanelles, Montezuma, Solo, Alpha, Bonanza King and Wellington. In addition to these are the Yosemite, Reco, Monte Christo, Sunset, Scottish Chief, Stranger, The Noble Five, Lucky Jim, Payne, World's Fair, Beaver, Lincoln, White Water, Echo, Ajax, Tam O'Shanter, Revelstoke, Lucky Boy, Porcupine, Greenhorn, Robert E. Lee, Ruby Silver, Great Western, Grizzly Bear, Slocan Star, Honeycomb, and many others included in the Bremen and Jardine camps.

At least 1,500 tons of ore will be delivered at Kaslo this winter, by George Hughes, from the Freddy Lee, Blue Bird and Idaho, besidss the ore which is being shipped by McMahon from Four-Mile Creek to Nakusp.

The town of Kaslo has sprung into existence with the opening of Slocan and is, perhaps, the most important representative mining town in the Province. The citizens are public spirited and not afraid to venture a few dollars when funds are required to promote the interests of the town and the country around it. The construction of a wagon road to Bear Lake and sleigh roads to the various mines from that point, is an evidence of the sort of men who have established themselves at Kaslo.

Next year will see this town advance to the rank of a city, with banks, warehouses, Board of Trade and other metropolitan improvements, such as electric light and waterworks system. This place may have a rival later on in New Denver, but any rivalry between Kaslo and Nelson is absurd, as the latter place occupies a position which does not enter into conflict with the other points.

Transportation facilities will, no doubt, have a marked effect upon the future of all towns in West Kootenay, but so far, both Nelson and Kaslo have secured a vantage ground in their relative situations from which it will be hard to dislodge them. The future of New Denver is most hopeful, but it is at the mercy of those companies who build railroads and their connections, though its situation is more favorable for securing all the trade tributary to Slocan Lake.

A novel object to be found in Slocan is a boulder of galena weighing 122 tons, which lies below the Slocan Star and is supposed to have come from that vein. It weighs 122 tons by measurement and assays 186 oz. silver, which makes its assay value over $20,000.

Another interesting feature of the district is the carbonated mineral springs, discovered by Mr. Kemp and situated about four miles back of Kaslo on the road to Bear Lake.

The temperature is 38° F., and constituents :—

Lime Carbonate	83·50	gr. per gal.
Magnesia	12·85	" "
Soda	5·50	" "
Potash	·40	" "
Carbonate of Iron	0·56	" "
Sodium Chloride	1·20	" "
Silica Allumina and Phosp. Acid	3·20	" "
Lithia	Not determined.	

It may be interesting to know that the ore chute on the Bonanza, one of the group of Noble Five, is 10 feet 7 inches wide—4½ feet chlorides, 3 feet of galena, and balance carbonates. This is generally admitted to be the biggest showing in the district, but there are other properties which also have enormous ore bodies. The quality of ore is more remarkable than the quantity, and it may be said, to the lasting credit of this camp, that it is the richest in general average ever discovered in any country in the world. It is to this fact more than any other that Slocan owes its phenomenal development.

The old adage says, "When it rains it pours," and certainly West Kootenay has been deluged this season with mining discoveries.

No sooner had Slocan become a standard topic, when a new district was heard from, viz., The Lardeau. The country has been known for a long time past in a general way, because of its accessibility and usefulness as a railroad route from the north arm of Arrow Lake to the head of Kootenay Lake. Some places have also been worked at various periods, which made the district known to some of the old timers, but as a quartz district it was unknown.

The Lardeau country stands relatively in the same position as Slocan, one year ago. The discoveries were made too late for large developments to take place this season, but the size of the lodes and extent of their ore bodies make it possible to state that its future is already assured, and next season will no doubt add richly to the discoveries already made.

The centre of the district is Trout Lake, and having personally visited the spot, we know it to be a paradise for fishermen and hunters. At both ends of the lake are flats, which will furnish fine situations for towns, and as the mines are approached from these points, it is safe to predict that towns will spring up there next year. The various groups of mines known are, Great Northern and True Fissure, discovered by Messrs. Downs, Walker, Holton and Stobard—this is a bonanza ; C. F. Blackburn's group, six claims ; Thos. Homes' group, four claims ; Poole & Crockell, two claims ; Ben. Raimie's group, with extensions owned by others. These are all situated on the north fork of the Lardeau and directly accessible from Arrow Lake or Trout Lake.

On the ridge between the South Fork and Trout Lake are situated the Abrahamson Bros.' group of three parallel

lodes, the Silver Cup claim, owned by Great Northern locators and others. These claims can be approached either from Trout Lake or the South Fork. At the head of the latter stream are claims known as the Gainer group. This is on the same contact as the Haskins, Wagner and Sevoy groups, only the latter are more easily approached from Haley Creek, at the south end of Trout Lake.

The Haskins group is a very remarkable exhibit and only confirms the general character of the ore bodies in Lardeau. The most interesting feature of the ores is the amount of gold which accompanies the silver. In some instances it amounts to as much as the silver product, and this of course adds greatly to the importance of the district. The average value will be from 50 to 100 per cent. in gold and silver. This is distinctly high grade and when taken in conjunction with the fact that the ore bodies are very large, we have a presentation which gives assurance of a great future for the district, without taking into account the discoveries which may be made next season.

Another district of great promise, but as yet scarcely touched, is what is known as the Duncan River country. We may have to repeat, next year, about this district, what we have already said about the Slocan and Lardeau belts, but in addition thereto, we look forward to the discovery of a rich gold belt on the east slope of the Valley, as it is hereabouts that gold quartz lodes of great promise have already been found.

Along the line of the C. P. R. at Illecillewaet, and Fish Creek a large amount of development work has been done, and it is noteworthy of remark that many prospects are passing into the hands of good men, who have an abiding faith in the future of claims in the railway belt. The Lanark and Maple Leaf properties are still the most important, and it is a matter of regret that so much ore should remain in the mines when it can be sent to market. The Elizabeth claim, on Fish Creek, ranks first in importance among many good prospects, and the Dunvegan is expected to become a producer next year, after lying idle for too long a time. The country to the north, between Illecillewaet and Big Bend, is yet to be prospected, and will no doubt prove up good.

In Big Bend district we expect that good gold quartz will be found, as some very good ores were brought into Revelstoke this fall. The Consolation mine and other gravel diggings have done very well, and we hope will continue to do so, as much work has been done by those interested.

Some day the town of Revelstoke will wake up to find itself the centre of a great mining district. and then we hope to see its smelter in operation. In East Kootenay the mining situation remains much the same, except a most important discovery was made in Fort Steele district by Joseph Bourgeon, which will lift that portion of the country into great prominence. It is known as the North Star; is between 20 and 30 feet in width and assays 40 oz. silver. We are quite sure that the people who have taken over this property will be turning out bullion by next season.

The Thunder Hill, under Mr. Brady's management, is the most important enterprise in the district, and has passed the stage of exploration for the more solid one of production. The concentrating plant will be at work 1st March next. Mr. Fred. Wells marketed a carload of ore at Tacoma, which places Vermont Creek mine still at the front, and we understand that Messrs. Wells & Pollock intend to make continuous shipments of ore to Tacoma next year for treatment. If the average obtained will reach same as the last two cars, they will realize a handsome sum for the year's work.

The St. Mary's district gives greatest promise of any portion of East Kootenay, as so far the largest ore body yet discovered has been found there, and important gold finds have been made in the same vicinity late this season.

On Vancouver Island, a little placer mining has been carried on by Chinese on several streams heading into Barclay Sound. Some development work has been done on an extensive deposit of quicksilver, on Sechart Inlet. A number of ledges of gold-bearing quartz have been treated, samples of which have assayed very satisfactorily. Little has as yet been done towards their development, though there seems every reason to believe that gold-bearing quartz exists in considerable quantities in the hills adjacent to the West Coast. Iron of the finest quality has been located in immense bodies in several places along the west coast of Vancouver Island, and convenient to the water, in one or two cases on the water's edge.

The Behavior of Coal during Combustion.—Mr. B. Holgate, M.A.,* describes the variations of the behavior of coal during combustion. Cannel coal contains a considerable quantity of fish remains, and was deposited under water. When coked the lumps retain their original shape. Most other coals are somewhat simllar in composition to one another, so that analysis alone will not determine their burning qualities. The appearance of coal is a much better guide. Some coals require a high temperature and a strong draft to burn properly, such as the better bed coal of Yorkshire. As a general rule, coal which breaks naturally into small will not deliver its gas so freely and will not burn so readily, but it makes the best coking coal when it is soft and breaks up easily. When the coal breaks into large lumps the gas can get away more readily.

* Lecture delivered before the Yorkshire College Engineering Society.

Coal Exports From Canada.

Coal exports from Canada during the fiscal year ended 30th June, 1892.

Country.	Tons.	Value.
From Great Britain	22,920	$53,101
" British Guiana	2,515	7,545
" British West Indies	7,081	18,511
" British Poss., Pacific Ocean	1,404	5,616
" Australia	1,102	4,408
" Hong Kong	9,915	37,170
" Newfoundland	99,972	202,607
" Belgium	400	800
" China	1,149	3,834
" Germany	150	450
" Holland	700	1,445
" Japan	1,226	4,571
" Russia	1,181	4,724
" St. Pierre	14,035	30,413
" Sandwich Islands	4,222	16,888
" United States	772,441	2,790,693
" SouthWest Indies	4,712	12,691
Total	945,125	$3,195,467

The Cape Breton Coal Syndicate.

AN ENGLISH VIEW OF THE SITUATION.

During the past week, says a correspondent to the *Colliery Guardian*, several announcements have been made to the effect that American capitalists have acquired control of the collieries of Nova Scotia—lately described in these columns. As a matter of fact, this has been pending for some time. The semi-alarmist character attached to some of these announcements is misleading, and excites some mistrust of the insight into surrounding circumstances which Press correspondents are supposed to possess, especially as no mention is made of the fact that in purchasing the Canadian collieries the New England consumers have a length procured a source of supply for their 16,000 factories, independent of the capricious exactions of Pennsylvanian, Virginian, and Maryland producers and carriers. The rapid growth of the coal and iron industries of the south, and the more general distribution of centres of production over the states of the American Union have rendered some such independent source of supply absolutely indispensable to the north, if she is to hold her ground at all. Formerly coal, iron ore and all the allied raw materials were carried into New England as a matter of common usage, and manufactured into various articles for distribution all over America. In the natural order of things, however, this could not continue; manufacturing industries are now conducted, where neighboring and cheap supplies of raw material are obtainable, and from being the foremost manufacturing state, Massachusetts has now declined to third among the states of the Union. Notwithstanding this severe blow, many of the industries of the state have still survived, but of late, the ever-growing pressure of keen competition, allied to the severe transit and material monopolies of the south, have operated most heavily against the obstinate success of the north. The expression "obstinate success" is used advisedly, for sheer obstinacy has alone enabled the Northern States, far from all supply and surrounded by every possible impediment, to retain sufficient prestige to make Massachusetts a household word among 60,000,000 people, as a manufacturer of cotton, woollen, and other useful articles. This state, containing 238 inhabitants per mile, annually consumes £80,000,000 worth of raw material, nearly all of which is imported from her sister states, and in all this possesses no available deposits of native raw material nearer than that of her jealous and sometimes unscrupulous rivals. The principal parts in the rival states from which her supplies are drawn are distant from Boston as follows: New York, 292 miles; Philadelphia, 480; Norfolk and Newport, 620; Baltimore, 880; or an average distance of 550 miles; but to this must be added the distance from the mines to the above ports, such as 250 and 335 miles from Clearfield to Philadelphia and New York respectively, and 290 and 196 miles from the Cumberland mines of Maryland to Philadelphia and Baltimore respectively; so that Massachusetts has to purchase all her raw material, plus this land and sea transport, both of which are subject to the enormous extortions of monopolists. As on coal alone the consequent loss to the New England States is estimated at £1,000,000 sterling per annum, it is not at all surprising that the northern manufacturers and coal or iron consumers should have long meditated a *coup de main* in Nova Scotia, which is the only country so situated geographically as to be able to come into competition with the south. In Nova Scotia, unlike the latter districts, no very pronounced or vexatious monopolies or combines, either in mines or transit arrangements, hamper the cheap getting of raw material. The mines, especially in Cape Breton Island, notably at Cow Bay, Glace Bay, or Mira Bay, are actually on the coast, close to fine harbors, and are operated with exceptional ease and economy, being also capable of development to a sufficient degree to meet the annual consumption of the New England States, which is now set at 1,000,000 tons. As long as the Harrison Government remained in power, however, Pennsylvania and the south succeeded in upholding the duty on Canadian coal and held the New England Democrats in check, quashing every petition to Congress, notably that of the autumn of 1891, which called for free coal, iron ore and coke, backed as it was by 237 of the leading directors and managers of New England iron-making establishments. Consequently all attempts to place Nova Scotian coal properties on the Boston market during the Harrison tenure have proved fruitless until the present time. Now that the vested interests of the south have suffered a reverse in the defeat of General Harrison, a modification of the coal duties looms sufficiently near to tempt the northern consumers into a consummation of their long-cherished plans, and the collieries have been bought. That these purely commercial arrangements imply anything like a gigantic monopoly of North American coal from Labrador to the Gulf of Mexico is, of course, as impossible as untrue. It is most unlikely that the lion of Pennsylvania will lie down with with the lamb of Massachusetts, and as far as the latter is concerned it is equally impossible that Boston or New York, by the mere acquisition of the Nova Scotian collieries, could control the Caandian coalfields, for irrespective of wealthy and unexploited coal areas of New Brunswick and Western Cape Breton, vast areas of the undeveloped Nova Scotian coalfields proper will be outside the new syndicate's control.

Breakage of Winding Ropes in Saxon Mines.

C. Menzel states that since 1884 the law has been enforced in Saxony that all breakages of winding ropes and chains shall be notified to the mine inspectors. The returns obtained in this way show that during the seven years ending in 1891 there were in all 133 breakages of ropes and chains in the Saxon mines. Of this total, 32 occurred in metalliferous mines, 97 in collieries, and 4 in lignite mines. The breakages during the various years were as follows:—

Year.	Metal Mines.	Collieries.	Lignite Mines.	Total.
1884	4	23	1	28
1885	2	20	1	23
1886	1	24	.	25
1887	3	12	1	16
1888	6	6	1	13
1889	9	8	.	17
1890	7	4	.	11

From these figures it is seen that, in the case of the collieries, although the output increased 5½ per cent. from 1884 to 1888, and then decreased, the number of breakages is considerably less, whilst the depth of the shafts has continuously increased. The majority of breakages, as would naturally be expected, occurred as the cage was being raised; in only 18 cases the breakage occurred as the cage was being lowered. The causes of the accidents cannot be ascertained with accuracy. Some 43 of the cases were, however, undoubtedly due to bad or worn material; 5 to 7 were due to imperfect welding, 20 to friction on the pulleys, and 20 to the jamming of the cage or kibble in the shaft.

The question whether it is desirable to have safety-catches or merely to trust to the rope being of good quality is not yet definitely decided by the mine managers. In the 79 cases in the collieries in which safety-catches were provided, they came into satisfactory action in 60 cases, or, in other words, 76 times in 100. These results certainly appear to he in favor of the adoption of safety-catches.

A Great Coal Shaft In the States.

The sinking of the largest coal shaft in the world by the Lehigh & Wilkesbarre Coal Company at Ashley, three miles from Wilkesbarre, Pa., has now progressed as far as the bed rock, which has been encountered at a distance of fifty feet from the surface. The shaft is 70 by 30 feet over all and will be 1,000 feet deep, penetrating to the red ash vein of coal. The size of the opening will be reduced to 55 by 14 feet by the banking of a five-foot wall and a hemlock cribbing. This wall will rest upon the solid rock fifty feet below the surface. The shaft will not only be the largest in dimensions of any in the world, but will have four compartments for hoisting coal, whereas the largest collieries have but two; and with the new breaker to be erected here, it is expected that the daily output and capacity will considerably exceed those of any anthracite coal plant in the world. The excavation of the soil has been rapid, and the refuse has been taken away by means of an overhead railway system. It has taken just one month to get through the quicksand bed, a foot think, which was near the rock. For this work caissons had to be constructed.

These new workings, with the development of the South Wilkesbarre shaft of the same company, will furnish employment to 1,500 extra men, a fact which is contemplated with pleasure by many hundreds of miners hereabouts, who are in constant fear of partial or total suspension of work at some of the other collieries. The South Wilkesbarre shaft has never yet been worked. It had just been prepared for mining operations when there came the terrible gas explosion two years ago, by which eighteen men were killed, the mine set on fire, and a large part of the cribbing and brattice work destroyed. Since that time the mine has been twice flooded, the first proving insufficient, and the destroyed timbering has just been replaced.

GENERAL PHOSPHATE CORPORATION.

Boodler Sando and Sir George Baden-Powell Retire from the Board—An Excerpt from the Directors' Report to be Presented at the Meeting of Shareholders.

The adjourned annual meeting of the General Phosphate Corporation, Limited, was held in London on 26th inst, and our next issue will contain an account of what took place. In anticipation of the meeting the directors issued a lengthy report, but owing to the accounts from Canada not having been received in time, only an approximate statement can be laid before the meeting. The accounts are to be audited immediately afterwards, the directors having thought it better to take this course rather than propose a further adjournment. "The directors much regret the absence of profits from which to declare a dividend." This result is attributed mainly to two causes—the present low selling price of phosphate, and the difficulties with which the directors have had to contend as regards the development and management of the Canadian properties. When the Company was formed the price of 80 per cent. phosphate delivered in this country was £5 3s. 4d. per ton, while now it has fallen to about £3. In regard to the second of the two causes mentioned, the administration of the Company's affairs in Canada was towards the end of last year placed in different hands. Mr. Alexander Benson was appointed manager and engineer at a salary of £300 a year, thus effecting a saving, while Mr. R. W. Shepherd, Jun., has been appointed general agent. The directors express their satisfaction at the fact that a charter has been obtained from the Canadian Parliament for the construction of a railway from a point near the Company's mines to Buckingham, where it will effect a junction with the main line of the Canadian Pacific. No progress has been made with the mining of mica on the Company's property. With regard to the actions that have been commenced by some of the shareholders for the removal of their names from the register, it is thought that a decision will be given by the courts within the next few weeks. "As regards the future policy of the Corporation the directors are in the hands of the shareholders. The directors think it would be much to be regretted if the work of developing and turning to account the Corporation's undoubtedly valuable properties were not continued, thereby losing the benefit of the money which has already been spent. This is one of the matters which they would be glad of the opportunity of discussing with a representative committee of shareholders. During the year the directors have lost the services of Sir Jacob Wilson and Sir George Baden-Powell, the first owing to his having received a Government appointment, and the latter owing to his engagement on the Behring Sea Commission. Professor Crookes and Mr. Sando have also reslgned."

Stopping Back Water by Brick Dams.—An account is given by Mr. J. Niven* of the brick dams constructed at the Mirfield Moor pit for stopping back a heavy feeder of water. During the sinking of a pit a large amount of water came from the river through an open-jointed rock, and had to be tubbed out. Coal was met at a depth of 457 feet, or 110 feet below the ordnance datum; and on driving towards the river two up-throw faults raised the coal 70 feet. These were cut through by a stone drift rising 6 inches to the yard, and the workings continued to a distance of 300 yards from the pit bottom. It was then found that a very large amount of water was coming through a stratum of 2 inches of soft dirt below the coal, and flowing down to the pit, where it had to be pumped from a depth of 200 yards. Brick dams were accordingly put both in the intake and return drifts. The dam in the intake was 10½ feet wide by 7½ feet high, and six courses of bricks in thickness, with 1 inch of cement between each course. The dam in the return was somewhat smaller. The floor, roof and sides were cut back 18 inches, and a 6-foot length of arching was placed on the outside of the intake dam, as the roof was weak. In ten days the pressure rose to 108 pounds per square inch, but the dams have remained tight. The cost of the two dams was £70.

Kelly's Sectional Boiler.—The sectional boiler built by Messrs. P. J. Powers & Co., Ottawa, for the Kootenay & Columbia Prospecting & Mining Co., reached Kaslo 10th January and was packed into the Wellington Mine, and commenced work 5 days thereafter. The boiler in every way is a complete success, so much so that Driller Kelly, the Inventor, has decided to have it patented in Canada and the United States. A second boiler with improvements in tubes, grate and firebox is now being built, and will be shipped to the Kootenay in March or April. Cuts of this boiler will appear in the March number of the REVIEW.

* Transactions of the Federated Institution of Mining Engineers, Vol. III, pp. 132-138, one plate.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Ontario.

Algoma Nickel Mines.—The three mines of the Canadian Copper Company are still closed down pending the decision of the courts in Ohio as to certain matters in dispute between the company and Mr. S. J. Ritchie, their former managing director here.

Mr. S. S. Ryckman, M. P., of Hamilton, Ont., has lately secured options on many valuable nickel properties on the range, presumably for a syndicate of English and American capitalists who wish to get an interest in the nickel mines here.

On lot 6, con. 3, Graham, some very high grade cohalt ore was discovered last summer, and the work of further exploiting the property will be started as soon as the snow leaves in the spring. Mr. J. C. Ryan, of East Saginaw, is also organizing a company to work an adjoining claim in the same township.

Mr. Arthur Kitson, of Philadelphia, has purchased a nickel property in Denison, and operations are expected to be commenced soon. Quite a number of other locations are to be opened up this year, and with the growing demand for nickel we look for unprecedented activity and interest in mining here before the present season is over.

The Worthington mine, in the township of Drury, is being worked this winter on a fair scale. About fifty men are employed in it now. A chute of exceedingly rich ore has been disclosed in one of the shafts of this mine, not far from the surface, and carrying over 40% of nickel. This is the richest nickel ore ever found in the district, except at the Vermillion mine.

Some of the finest nickel properties in the District are in the townships of Denison and Graham, where the range "gets her back up," rising in many cases into tremendous hills and ridges of ore above the surface. But their development is retarded by the want of a customs smelter at which ores could be sold. All the companies having smelters here now work their own mines and there is no local market for ores. It is estimated that $50,000 would build a custom smelter with a capacity of 100 tons a day, and such a needed enterprise, if properly managed, ought to pay well.

British Columbia.

Kaslo.

The stage line from Bonner's Ferry to Nelson, 65 miles, has been running since close of navigation. The fare is fixed at the moderate figure of $10 per passenger.

Blacksmiths' coal at Kaslo can be purchased for $80.00 per ton. (Ottawa Cartage Co. will please paste this in their hats.)

Two men were buried in a snow-slide at the Freddie Lee on January 3rd. The gang were working in the drift over which the slide passed. The mouth of the drift was blocked up for fifteen feet or so, and the miners had to dig their way out. Two whipsawyers making boards over a small pit had a miraculous escape, the slide being split by a rocky knoll sixty feet or so above them.

The Kootenay & Columbia Prospecting and Mining Company, and a Spokane syndicate each owning a half interest on the "Stanley," fifteen miles from Kaslo, intend commencing development work early in March.

Real estate has advanced from 300 to 500 per cent. in Kaslo since last spring. Corner lots in the business part of the town are stiff at $3,500. Stores with plate glass fronts, and first-class hotels adorn the town. "Seven-up Teas" and "Progressive Poker Parties" are all the rage this winter.

Twenty tons of silver lead ores are being hauled into Kaslo daily, awaiting opening of navigation. It is estimated that at least $500,000.00 worth of ore will be ready for spring shipment.

Miners' wages still continue at $2.50 to $3.00 per day and board. Provisions and horse feed are extremely high. Potatoes, $7 per bag; pork, $60; flour, $20; fresh beef, 20 cents. Dealers are paying $20 per ton at Nelson for ice.

Driving Levels in Hard Dolomite—A level has been driven by hand in very hard dolomite in the Raibl mining district of Carinthia. V. Waltl gives details regarding the running of this drift. During eleven months 777½ eight-hour shifts were worked off, 2,411 bore-holes were drilled, 2,701 drills were used; 344 lbs. of No. 1 dynamite, 107 coils of fuse, and 2,442 detonators were exploded, and 174 lbs. of linseed oil was also used. The holes were drilled, as a rule, to a depth of 17-7 inches. The drift itself was 7 feet 2 inches high, and 4 feet 7 inches broad. During the period above referred to it was driven 155 feet at a total cost of £90.

CANADIAN COMPANIES.

The West Isles Mining Company gives notiee of application for charter of incorporation under the statutes of New Brunswick. Authorized capital, $1,000,000, divided into 100,000 shares of $10. Directors: Henry B. Witter, Boston; James M. Lord, West Isles, County Charlotte, N. B.; Fred P. Greenwood, Boston. Head office: St. Stephen's, N.B.. Object: The mining and developing of mining properties, etc.

Anglo-Canadian Asbestos Co., Ltd.—At a meeting of the board of directors of this company held this month, a dividend of 20 per cent. on the year's operations was declared. A similar amount was paid in 1890 and in 1891.

MICA NOTES.

The Lake Gerard Mica System have closed down their Horse Shoe mine near Wilson's corners. The machinery and men are now at work on the "Nellie and Blanche," which is now employing about 50 men.

The Lake Gerard mine has now exposed the biggest show of crystals on record, estimated at 200 tons. Capt. Symons, late of the Bristol iron mines, is superintendent, vice E. B. Roche resigned. 49 hands are employed.

About 15 men are still working on the Thebret lot for the Lake Gerard System.

Mr. S. P. Franchot has nine men under Capt. Henwood mining spar and mica at the Villeneuve mine. The output of spotted and white mica averages about 1,600 pounds weekly and about three tons spar daily.

Mr. Chas. Pearson has five men mining spar on the Dwine lot, near Square Hill. Output about five tons daily. Over 400 tons of selected spar is now on the dump ready for hauling to Buckingham.

There are now three mica cutting establishments in Ottawa. One on Duke street, Chaudiere, one on Sussex street, and the third on Stewart street. The three factories employ about 90 hands.

Messrs. G. B. Hall, John C. Eno and Daniel McGie, of Quebec, are working a fine white mica property on the Saguenay, about 70 miles from Quebec. Mr. Hall was in Ottawa a few days ago and had 60 lbs. of samples of beautiful white muscovite cut to sizes from 3x4 to 9x5. William Campbell, late of Buckingham, is superintending the mine. Two cutters went from Ottawa last week. The output is in the vicinity of 18,000 lbs.

Mr. W. A. Allan is working five men on the Little Rapids for amber mica. About 60 tons is the output up to the end of January.

Messrs. Nellis & Gemmill have 120 tons mica stored in their sheds at Gow mine, Cantley. Seven men, under Wm. Stuart, Sr., are employed. The output averages from three to four tons weekly. Their show is the best looking one at present in the district.

Messrs. Lee Bros. have re-opened their Carey lot on Macgregor Lake. The mica pinched out and a phosphate deposit 60 feet by 12 has been uncovered, and about 225 tons, 85% lumps, are now on the dump. An offer for the lot of $12 per ton, f.o.b. Templeton, has been refused.

The same firm recently purchased lot 4, in 9th Range of Templeton, from the Templeton & N. O. Co. for $750. They took out 30 tons mica of fair average quality at a cost of less than $200, and re-sold the property for $4,000 to Ferguson Bros., of Montreal.

Messrs. Wilson & Chubbuck have recently purchased 300 acres in the 2nd Range of Wakefield, two properties are being developed with 12 men and show promising veins of high grade mica.

Compressed Peat Charcoal.—H. Ekelund, of Jonkoping, utilizes the heat from the cooling peat charcoal and the waste furnace heat to dry the peat preparatory to coking it, and in this way he is able to treat with advantage material too high in moisture to be otherwise employed. He gives a statement of the cost of production of such charcoal. Experiments with the Ekelund process of making coke from peat have been carried out at Omberg, near Motala, in Sweden. The furnace or oven is built of fire brick, and is divided into four chambers, 32 feet high and 20 feet square. The peat is conveyed on rails into the top chamber, where it is dried for two hours. It is then transferred through doors into the second, and then into the third chamber, in each of which it remains for two hours, and the coking is thus performed in two stages. After this the coke peat is transferred to the fourth or cooling chamber. The gas from the second chamber is passed through condensers to the third chamber, after which it is used for generating steam. The furnace will treat 10,032 cubic feet of peat, with the production of 48 tons of coke in the twenty-four hours. The coke is either compressed or is used as produced.

INTERNATIONAL MINING CONVENTION.

= Programme of =

MEETINGS, • EXCURSIONS • AND • ENTERTAINMENTS.

Tuesday, 21st February, 1893.

Opening of Convention in the Windsor Hall, (adjoining Windsor Hotel), by His Excellency the Governor-General:—Addresses will be delivered by the Hon. T. Mayne Daly, Minister of the Interior, the Hon. E. J. Flynn, Commissioner of Crown Lands, Que., and others. Thereafter Mr. John Birkinbine, President of the American Institute of Mining Engineers, will deliver his inaugural address on "The Development of Technical Societies." Chair to be taken at eight o'clock by the Hon. George Irvine, Q.C., President of the General Mining Association of Quebec.

Wednesday, 22nd February, 1893.

Morning, at Ten o'Clock — Opening Session of the Sixty-Fourth Meeting of the American Institute of Mining Engineers—Third Annual General Meeting of the General Mining Association of Quebec. — Special Meeting of the Mining Society of Nova Scotia — Meetings will be held in the Lecture Rooms "A," "B" and "C," in the Physics Buildings, kindly provided by the Governors of McGill University.

Afternoon, at Three o'Clock—Sessions of the American Institute of Mining Engineers, the General Mining Association of Quebec, and the Mining Society of Nova Scotia continued.

Evening, at Half-past Seven o'Clock—Visiting Members will be driven in sleighs, via Mount Royal and the Toboggan Slides, to the Club Houses of the Montreal and St. George's Snowshoe Clubs, where entertainment for the evening will be provided by the Snowshoe Clubs.

Thursday, 23rd February, 1893.

Morning, at Ten o'Clock—Meeting of American Institute of Mining Engineers continued.

Afternoon, at Three o'Clock—A United Convention of all visiting Societies and mining men will open—Papers on the Mineral Resources and Mining Industries of Canada—Canadian Mining Legislation, etc., will be discussed.

Evening, at Eight o'Clock—Session of United Mining Convention continued.

Friday, 24th February, 1893.

Morning, at Ten o'Clock—Session of United Mining Convention continued.

Afternoon, at Three o'Clock—Sleigh drive round the city—Visits to Engineering and Industrial Establishments, etc.

Evening, at eight o'Clock—The directors of the Victoria Skating Club, invite members of visiting Societies and their lady friends to a Fancy Dress Skating Carnival, in the Victoria Rink; they are also invited to the formel opening of the new Engineering Buildings, at McGill University, by His Excellency the Governor General.

Satuday, 25th February, 1893.

EXCURSION TO RADNOR FORGES, QUEBEC.

Party will leave via Canadian Pacific Railway (Dalhousie Square Station) at eight a. m. for Radnor Forges, arriving at 11.30. Luncheon will be served immediately on arrival. A visit will then be made to the furnace and works of the Canada Iron Furnace Company, Limited, operating an extensive area of bog and lake iron ores. The works are notable as being among the oldest on the continent, iron having been made and shipped from this point as far back as the sixteenth century. An opportunity will also be afforded of visiting the other works of the Company at various points in the vicinity. Tea will be served at Three Rivers at six o'clock. The party will return in time to reach Montreal for supper. Pullman coaches will be provided, and every arrangement made to ensure the comfort of visiting members and the ladies who may accompany them.

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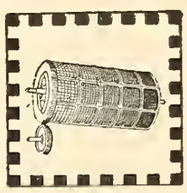

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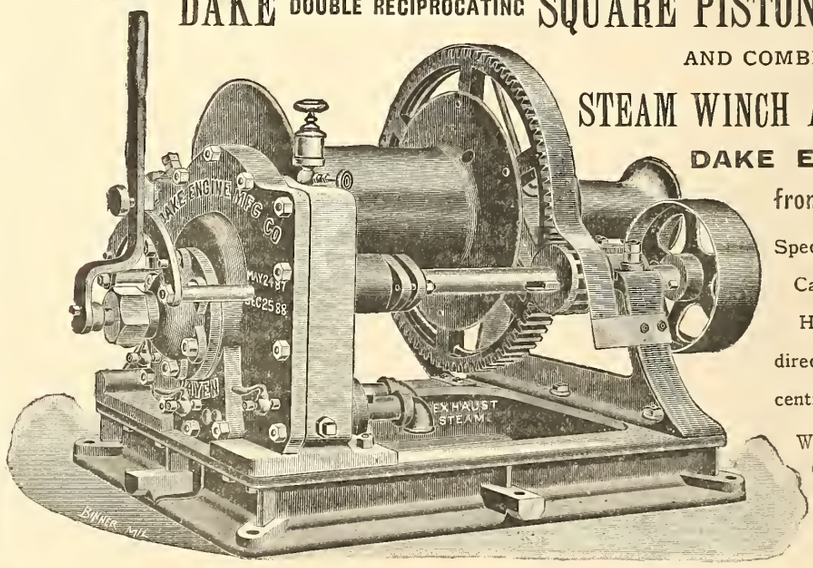

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New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. &. Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

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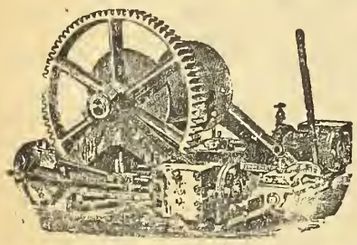

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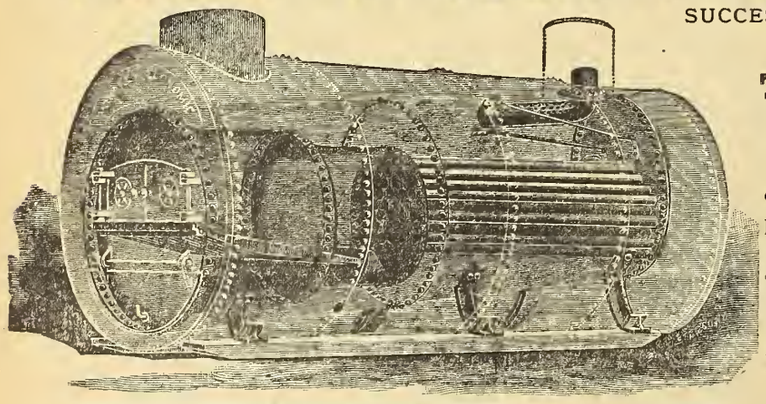

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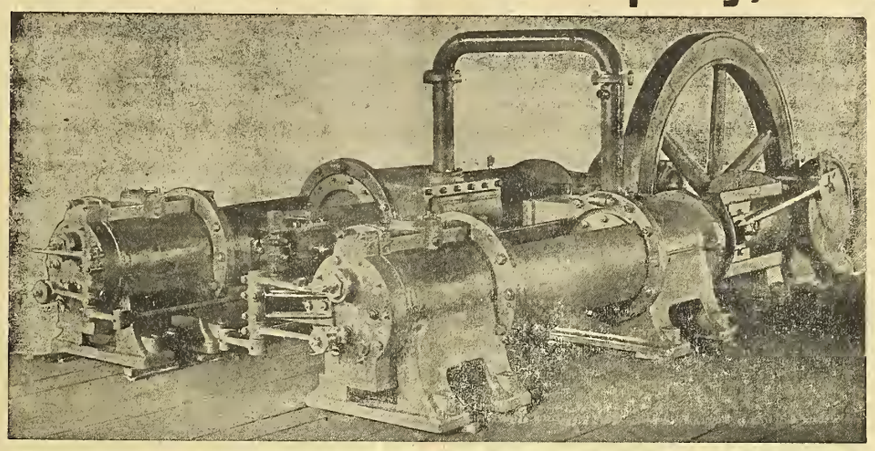

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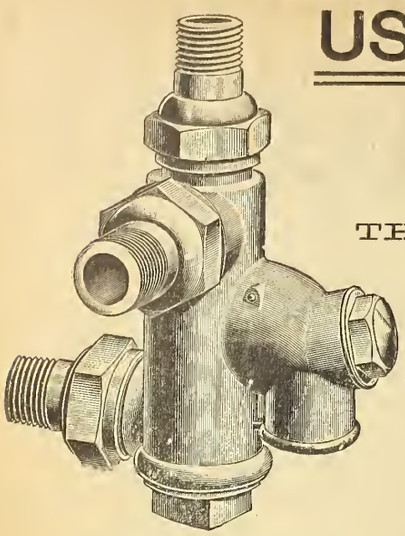

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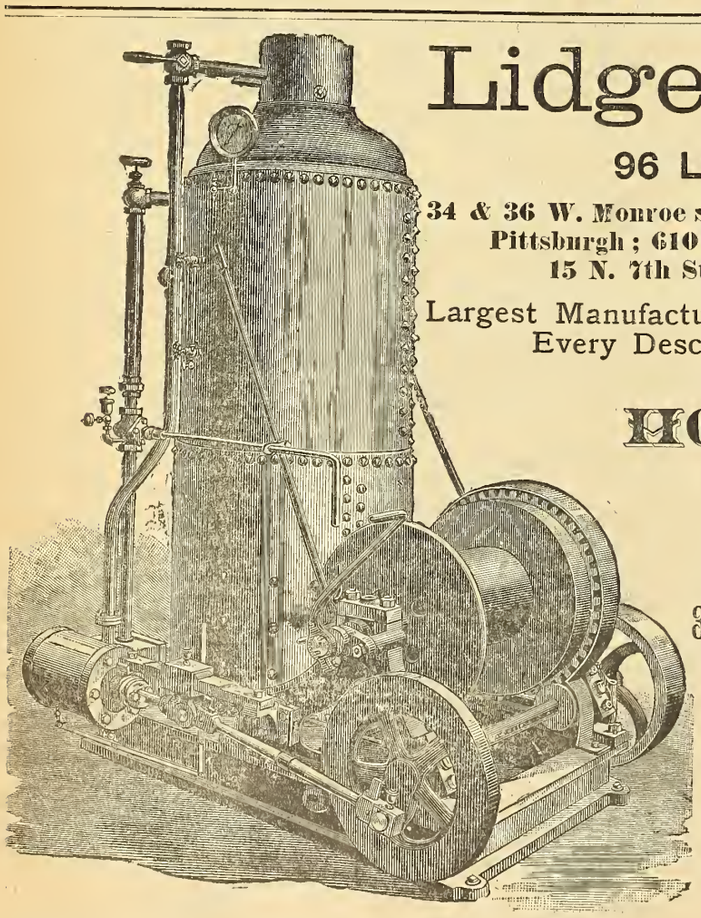

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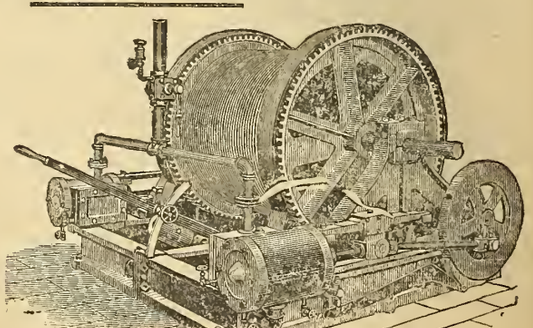

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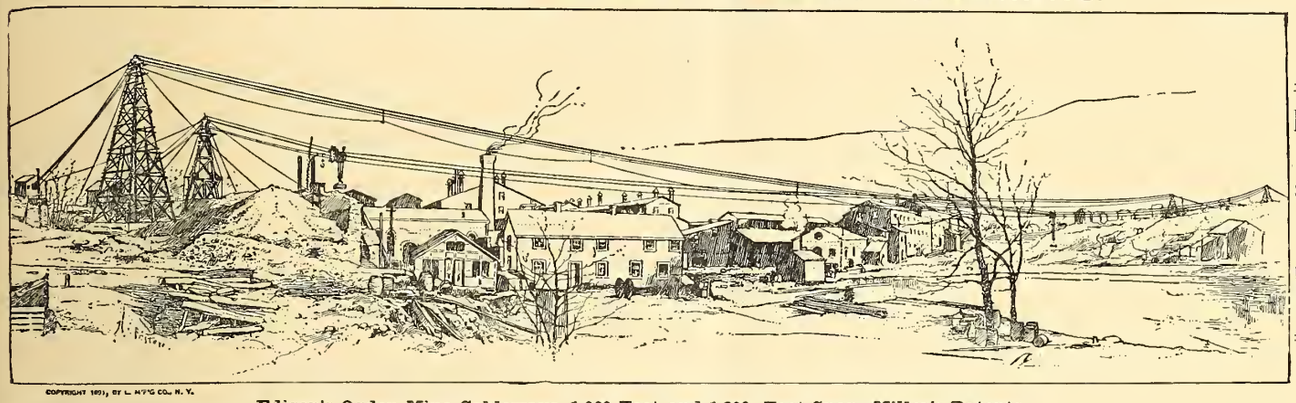

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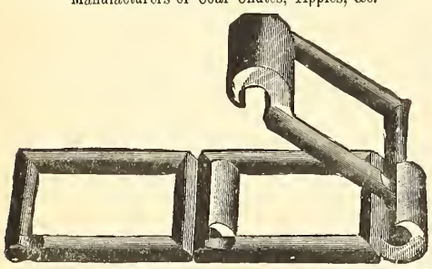

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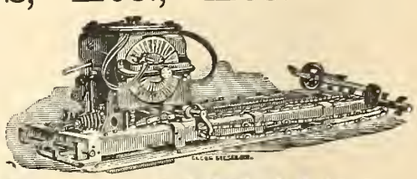

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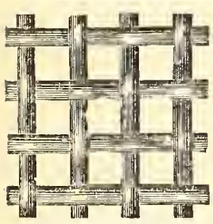

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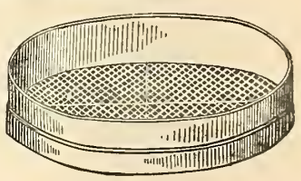

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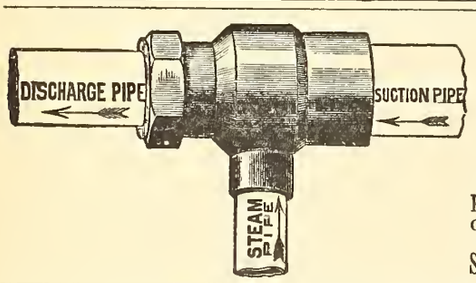

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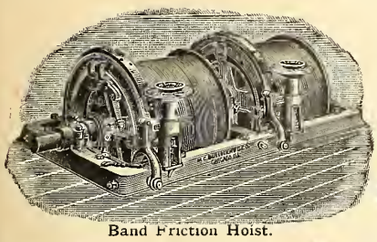

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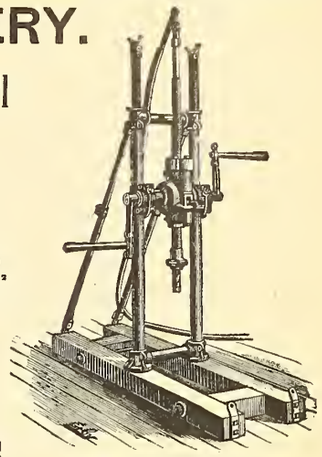

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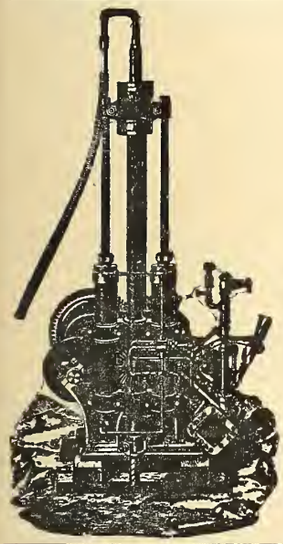

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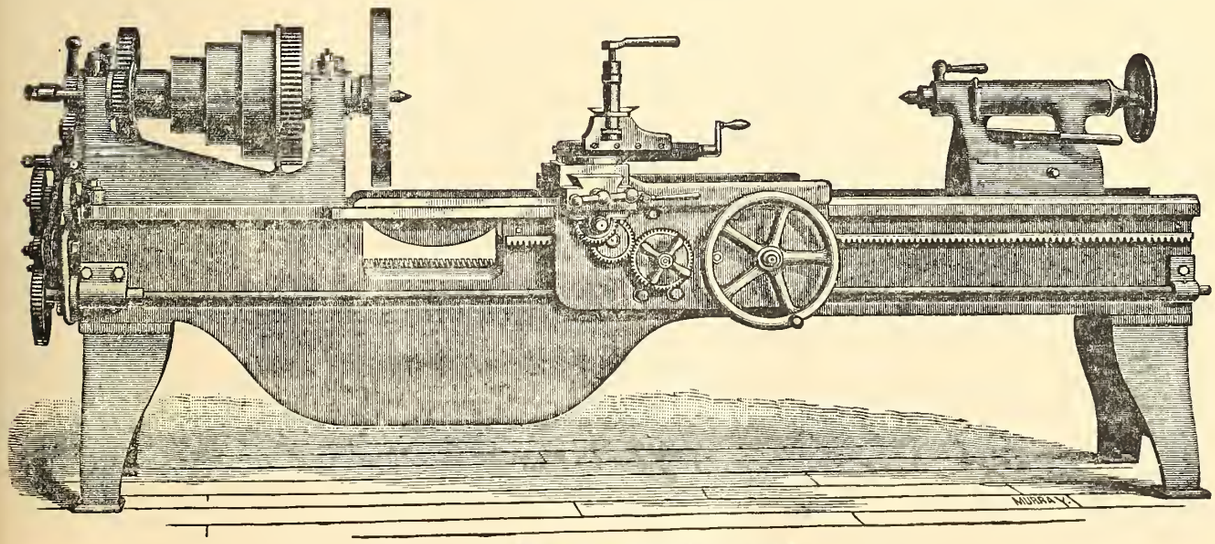

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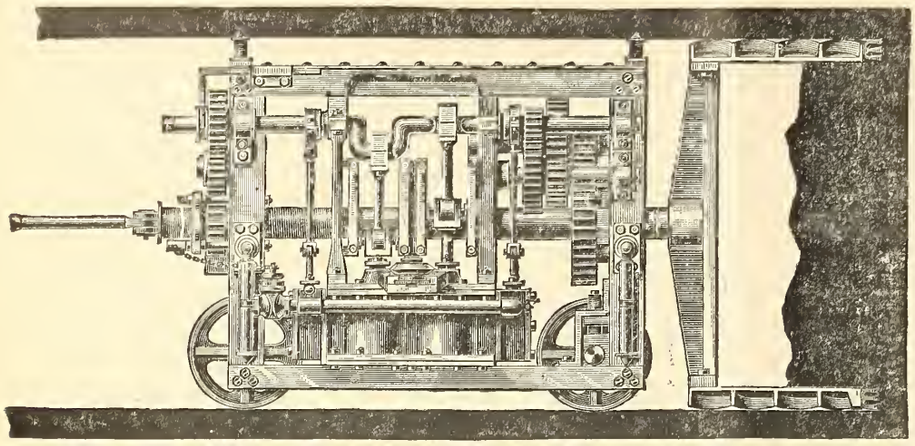

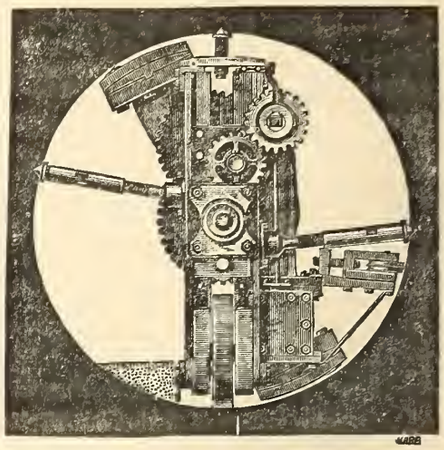

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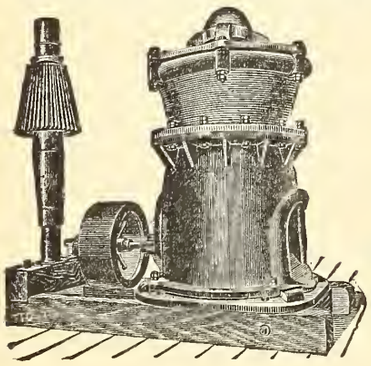

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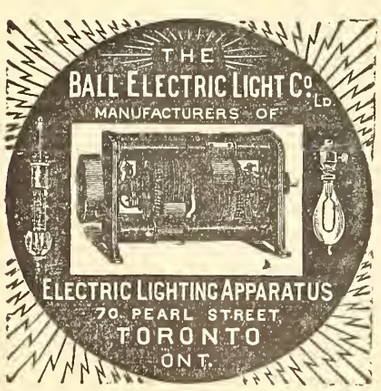

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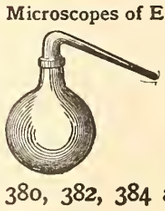

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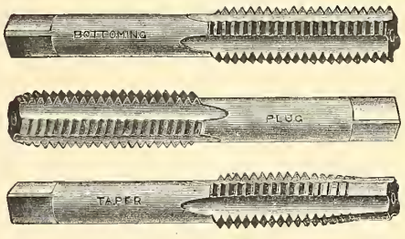

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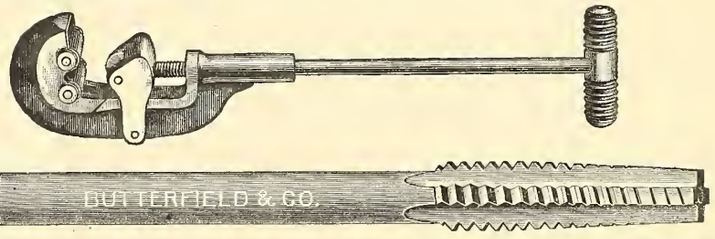

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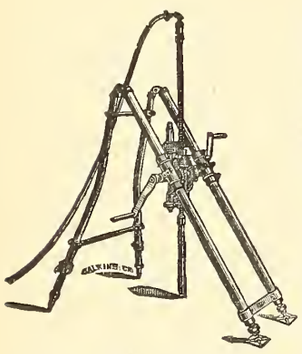

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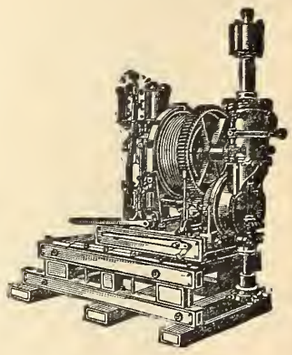

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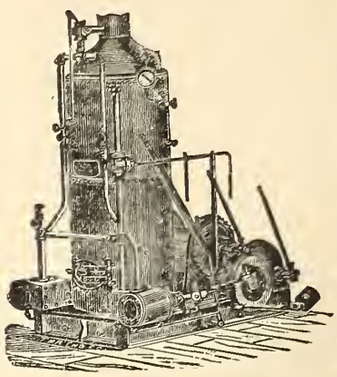

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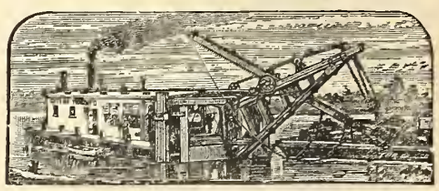

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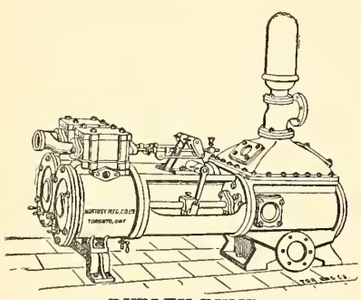

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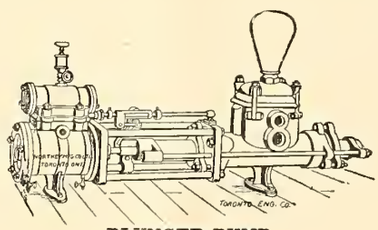

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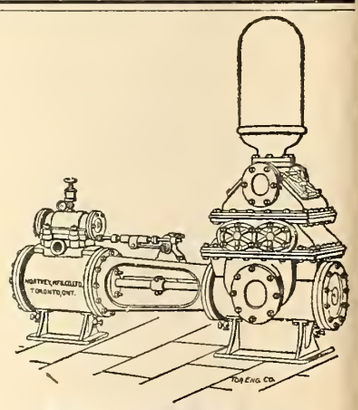

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Vol. XII. MARCH, 1893. No. 3.

THE INTERNATIONAL MINING CONVENTION

At Montreal.

The sixty-fourth meeting of the American Institute of Mining Engineers opened at Montreal on Tuesday evening, 21st February. Conjointly with the Institute there assembled the General Mining Association of the Province of Quebec, the Mining Society of Nova Scotia, the Provincial Mining Association of Ontario and the Asbestos Club. By kind permission of the Governors the various meetings were held during the week in the spacious and beautifully equipped lecture halls of the new Physics Building, at McGill University, on Sherbrooke Street.

It was originally intended that the opening proceedings should take the form of a reception by their Excellencies, Lord and the Lady Stanley, of Preston. Owing to the severe illness of one of his sons, necessitating the hurried departure of Lady Stanley for London, this feature, however had to be abandoned at the eleventh hour. The occasion was robbed of a good deal of interest too by the absence of the Hon. T. Mayne Daly, Minister of the Interior, Ottawa, the Hon. W. S. Fielding, Premier of Nova Scotia, (who was detained by a snow blockade) and the Hon. E. J. Flynn, Commissioner of Crown Lands, Quebec. These gentlemen had promised to deliver addresses but their parliamentary duties were found too pressing to permit their attendance. However, thanks to the courtesy of His Worship, the Hon. A. Desjardins, Mayor of Montreal and Madam Desjardins, who very kindly came to the rescue on a moment's notice, the evening's programme was carried out. The attendance of delegates in consequence mainly of the detention of trains was not so large as anticipated, the members of the Mining Society of Nova Scotia and many others being unable to reach the city until Wednesday morning.

The official register of attendance during the week was as follows :—

Adams, Capt. Robt. C. Anglo-Canadian Phosphate Co., Montreal.
Ayres, W. S., civil and mining engineer, Kenvil, N.J.
Ayres, Mrs., Kenvil, N.J.
Allan, W. A., Little Rapids Mining Co., Ottawa.
Allison, Robt., Franklin Iron Works, Port Carbon, Pa.
Allison, Mrs., Port Carbon, Pa.
Adams, F. M., Adams & Davis, New York.
Archibald, Charles, Gowrie Coal Co., Cow Bay, C.B.
Archibald, the Misses, Cow Bay, C.B.
Archbold, James, Scranton, Pa.
Archbold, Mrs. and the Misses, Scranton, Pa.
Addie, G. K., Sherbrooke, Que.

Barnard, F. S., M.P., Victoria, B.C.
Barnard, Mrs. F. S., Victoria, B.C.
Barnes, Geo. T., Philadelphia, Pa.
Barnes, Mrs. G. T., Philadelphia, Pa.
Boyd, H. A., Buffalo, N.Y.
Bagg, Mrs. Dr., New York.
Blake, Theo. A., New York.
Blake, Wm. P., Shullsburg, Wis.
Blake, Miss C. H., New Haven, Conn.
Barnes, Edward, Sunderland, England.
Blue, A., Director of Mines, Toronto,
Buck, F. P., Dominion Lime Co., Sherbrooke.
Birkinbine, John, Philadelphia.
Bell, B. T. A., CANADIAN MINING REVIEW, Ottawa.
Bell, James, Arnprior, Ont.
Bell, Dr. Robt., Geological Survey of Canada, Ottawa.
Bell, Mrs. Robt., Ottawa.
Burchall, Jas. T., Sydney Mines, C.B.
Burchall, Mrs., Sydney Mines, C.B.

Cleghorn, J. Raymond, Philadelphia, Pa.
Cleghorn, Miss Mabel, Philadelphia, Pa.
Cleghorn, Mr. Clarence, Philadelphia, Pa.
Cleghorn, Mrs. Clarence, Philadelphia, Pa.
Coleman, Prof. A. P., Toronto, Ont.
Carriere, C. H., Levis, Que.
Chown, Chas. D., Kingston.
Circkel, C., Templeton Asbestos Co., Templeton, Que.
Cameron, Ian., Dominion Mineral Co., Sudbury, Ont.
Conyngham, J. N., Wilkesbarre, Pa.
Conyngham, Mrs., Wilkesbarre, Pa.
Conyngham, Col. C. M., Wilkesbarre, Pa.
Conyngham, Miss, Wilkesbarre, Pa.

De Camp, Mr. W. S., New York.
De Camp, Mrs. W. S., New York.
De Camp, Miss, New York.
Day, Dr. David T., Washington.
Day, Mrs. David T., Washington.
Day, Mrs. W. C. Sworthmore, Pa.
Dowling, D. B., Geological Survey, Ottawa.
Drummond, G. E. Canada Iron Furnace Co., Montreal.

Egleston, Prof. T., Columbia College, New York.
Eustis, W. E. C., Eustis Mining Co., Boston.
Evans, A. M., King Bros. Asbestos Mines, Black Lake, Que.
Ells, Dr. Robt., Geological Survey, Ottawa.

Fergie, Chas. Drummond Colliery, Westville, N.S.
Futvoye, J. B., St. Johns, Que.
Fielding, Hon. W. S., Halifax, N.S.
Francklyn, G. E., General Mining Association of London, Halifax, N.S.
Franklyn, Mrs., Halifax, N.S.
Fraser, Graham, New Glasgow Coal and Iron Co., New Glasgow, N.S.
Franchot, S. P., Emerald Phosphate Co., Buckingham.
Franchot, Mrs., Buckingham.
Faribault, E. R., Geological Survey, Ottawa.
Francis, Lewis W., Port Henry, N.Y.

Garrison, F. Lynwood, Philadelphia.
Gue, T. R., Acadia Powder Co., Halifax.
Garvin, J. M., Rock Run., Alabama.
Greene W. H., Philadelphia.
Giroux, N. J., Geological Survey, Ottawa.

John Birkinbine, M. E., Philadelphia, Pa., President American Institute of Mining Engineers.

Howe, Dr. Henry M., Boston.
Howe, Mrs. H. M., Boston.
Hines, Samuel, Scranton, Pa.
Hines, Mrs. Samuel, Scranton, Pa.
Haycock, E. B., Ottawa, Ont.
Harris, O. M., Montreal.
Hammond, James B., Sudbury, Ont.
Hanson, E., Montreal.
Hooper, William B., Rambroyn, N. Y.
Higginson, T. S., Buckingham.
Hegeler, J. W., La Salle, Ill.
Hayes, C. Willard, Washington.
Hardman, J. E., Oldham, N. S.
Hopper, R. T., Montreal.
Halsey, F. A., Sherbrooke.
Halsey, Mrs. F. A., Sherbrooke.

Irvine, Hon. Geo., Q. C., Johnson's Co., Quebec.
Irwin, W. H., Anglo-Can. Asbestos Co., Montreal.
Inman, A. L., Pittsburgh, Pa.
Inman, Wm. John, Plattsburgh, N. Y.

Jeffrey, W. H., Danville Asbestos Mines, Danville, Que.
Jones, John P., Iron Mountain, Mich.
Jones, Miss, Iron Mountain, Mich.
Johnson, C. S., Iron Mountain, Mich.
Johnson, Hon. Cecil, Harkness Hall, Scarboro', England.

Kirkwood, T. M., Sudbury.
Klein, L. A., American Asbestos Co., Black Lake Que.
Kirchhoff, C., New York.
Kirchhoff, Miss Lindon, New York.
Kennedy, John S., New Glasgow Coal and Iron Co., Ferrona, N. S.

Leckie, R. G., Londonderry, N. S.
Leckie, Mrs. R. G., Londonderry, N. S.
Leckie, R. G. E., Torbrook, N. S.
Lyman, Frank, Brooklyn, N. Y.
Lennon, G. H., Sudbury.
Lindsley, Stewart, Orange, N. J.
Lehman, Ambrose E., Philadilphia.
Lynch, W. H., Kootenay, B. C.
Leonard, Gardner C., Albany, N. Y.
Lidgey, Hubert, Murray Mine, Sudbury, Ont.
Lowe, A. P., Geological Survey, Ottawa.
Leofred, A., Quebec.
Laine, D., Levis, Quebec.

Moore, W. B., Pictou Charcoal Iron Co., New Glasgow, N. S.
Montague, Thomas, New York.
Mickle, G. R., Sudbury, Ont.
Moen, Philip, Worcester, Mass.
Morgan, C., Toronto.
Merritt, W. Hamilton, Toronto.
Medbury, Chas. F., Montreal.
MacIntosh, William, Buckingham.
Marcotte, J. A., Black Lake, Que.
Miller, J. B., Toronto.
Macdonald, Alex., St. Johns, Que.
McKay, John, Sault Ste Marie, Ont.
McConnell, Rinaldo, Mattawa, Ont.
McCormick, Henry, Harrisburg, Pa.
McCormick, Miss, Harrisburg, Pa.
McNaughton, James, Albany, N.Y.
McLennan, J. S., Dominion Coal Co., Boston.
McDougal George, Crescent Gold Co., Malone, Ont.
McEvoy, Jas., Geological Survey, Ottawa.
McDuff, George, Waverley, N.S.
McInnes, Wm., Geological Survey, Ottawa.
McRae, Hector, Electric Mining Co., Ottawa.
McGuiness, Miss, Dunnville, Pa.
McGee, Chas., Bristol Iron Co., Ottawa.
Nason, H. B., Troy, N.Y.
Nicol, Prof., Kingston, Ont.

Obalski, J., Inspector of Mines, Quebec.

Pardee, J. P., Stanhope, N.J.
Pardee, Mrs., Stanhope, N.J.
Phillips, W. B., Engineering and Mining Journal, N.Y.
Penhale, Matthew, Glasgow and Montreal Asbestos Co.,
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Papineau, J. M., Montreal.
Peters, Richard, Jr., Philadelphia, Pa.

Raymond, Dr. R. W., New York.
Rossi, A. J., New York.
Richards, Robt. H., Boston.
Ramsay, W. M., Montreal.
Robb, D. W., Amherst, N.S.
Richardson, Prof. C. G., Toronto.
Rutherford, W., Toronto.
Russell, Walter S., Detroit, Mich.
Reid, Hon. James, Quesnelle, B.C.
Robert, J. A., Montreal.

Stevenson, A. W., Montreal.
Scaife, W. L., Pittsburgh.
Smith, Prof. T. Guilford, Buffalo.
Smith, Mrs. T. G., Buffalo.
See, Horace, New York.
See, Mrs. Horace, New York.
Smith, George R., Bell's Asbestos Co., Thetford, Que.
Selwyn, Dr. A. R. C., Geological Survey, Ottawa.
Speague, T. W., Boston.
Smock, J. C., Newton, N.J.
Smock, Mrs. J. C., Newton, N.J.
Smaill, Wm., Londonderry Iron Co., Londonderry, N.S,
Smith, J. Burley, British Phosphate Co., Glen Almond, Que.
Scott, George S., New York.
Sjostedt, E., Pictou Charcoal Iron Co., Bridgeville, N.S.
Spotswood, Geo. A., Kingston.
Struthers, W. D., Sudbury.
Swenzel, Miss, Scranton, Pa.

Taylor, Francis D., Montreal.
Torrey, H. C., New York.
Torrey, Mrs., New York.
Torrey, J. Gray, New Jersey.
Taylor, C. H., Montreal.
Taylor, Chas., Montreal.
Totdt, E. B., Albany, N.Y.
Totdt, Mrs. E. B., Albany, N.Y.
Tratman, E. E., Russell.
Tyrell, J. B., Geological Survey, Ottawa.

Viele, Mrs. M. J., Plattsburgh, N.Y.

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Wellman, S. T., Thurlow, Pa.
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Woodworth, G. L., Belmont Iron Co., Marmora.
Wills, Mrs. J. Lainson, Ottawa.
Williams, H. H., Quebec.
Witterbee, F. S., Port Henry.
Williams, Oliver, Catasauqua, Pa.
Williams, Mrs. O., Catasauqua, Pa.

Reception in the Windsor Hall.

Shortly after eight o'clock the Hon. George Irvine, Q.C., President of the General Mining Association of Quebec, accompanied by His Worship Mayor Desjardins, took the platform. There were seated around him Mr. John Birkinbine, Philadelphia, President, and Dr. R. W. Raymond, Secretary, of the Institute; Mr. A. Blue, Director of Mines for the Province of Ontario, Toronto; Mr. F. Barnard, M.P., Victoria, B.C.; Mr. Macdougall, M.P., Sydney, C.B., Mr. J. Obalski, Inspector of Mines for the Province of Quebec; Capt. Robt. C. Adams, Vice-President General Mining Association of Quebec, Montreal; Messrs. W. H. Irwin and R. T. Hopper, Anglo-Canadian Asbestos Company, Montreal; Mr. A. W. Stevenson, Treasurer, and Mr. B. T. A. Bell, Secretary, General Mining Association of Quebec, and others. Altogether the attendance numbered about six hundred. There was a goodly attendance of ladies, many of them in evening dress, and the conventional dress suit was as prevalent and as acceptable as buds on a maple tree in April. The proceedings were enlivened by an excellent selection of music, given by the full band of the 1st Victoria Rifles.

HON. GEORGE IRVINE.—Ladies and gentlemen: In connection with my duty as president of the General Mining Association of the Province of Quebec, to preside at this meeting, you will be glad and relieved to know that it is not part of that duty to make a speech. I have, however, the pleasure of being able to tell you that there are other gentlemen here who will give you much more sound talk and eloquence than I could offer. I regret very much to say that several prominent men, whom we expected would take part in this evening's programme, have for one reason or another been prevented from attending. His Excellency the Governor-General, who was to have spoken at this convention, was unable, for reasons which he has explained to Mr. Bell, our Secretary, to come. The Lieutenant-Governor of Quebec, I am sorry to say on his own account and yours, is confined to his house through illness. It might be well perhaps to read to you telegrams and letters of regret which have been received from the several gentlemen who were to have been with us, but were prevented. (President Irvine read telegrams and letters of apology from His Excellency, Lord Stanley, His Honor the Lieutenant-Governor of Quebec, the Hon. T. Mayne Daly, Minister of the Interior, and the Hon. E. J. Flynn, Commissioner of Crown Lands, Quebec.)

We have therefore to forego the pleasure of listening to these gentlemen. I have on behalf of the General Mining Association of the Province of Quebec to welcome in the most cordial manner the mining engineers and their ladies and friends from the United States and Canada who have come here to attend this Convention; and particularly the ladies, who have already I hear, softened by their loveliness and graciousness the heart of old King Fost himself. We hope that by our best endeavors you may be enabled to enjoy to a full extent your visit. We feel a desire to do this more particularly because of the fact that when our people have visited the United States they have invariably been received with the greatest cordiality, kindness and hospitality; and we would like to show them that that kindness has been appreciated. I have now much pleasure in calling upon his Worship the Mayor to address you.

MAYOR DESJARDINS.—Ladies and gentlemen: We have just heard the letters of regret read which have been received from the distinguished gentlemen who were to have been here; and I am sure that deplorable fact has given you much disappointment. The fact that I am called upon to replace in part such well known orators proves that you are to be still further disappointed. I must tell you that when Mr. Bell, the Secretary of the Convention, invited me a few days ago to attend this opening, I felt he was paying me a great honor, but while I accepted, I did not know that it would be in the capacity of Mayor of Montreal that I would serve. For we in Montreal during the last few weeks have been in what I may call a condition of doubt. No one knew who was mayor. One day you would hear somebody say: "I am the mayor;" and the next day another voice would make a like assertion, and with equal confidence. And I myself, although I claimed also to be the mayor, was not altogether certain of the truth of the matter. However, I am here to-night, and I *am* the mayor.

And as such, ladies and gentlemen, allow me to say that we, the people of Montreal, are highly gratified at the choice which you have made in selecting this city of ours as the seat of the meetings of this great Convention. We welcome you cordially, and we hope that your stay with us will be pleasant, and that the people will show such interest in the labors which you are about to undertake, that you will carry home with you the most agreeable recollections of your sojourn among us. You will forgive, I am sure, the lamentable fact that the snow has prevented, by blocking the trains, so many of your delegates from being in time to attend here this evening; although they will have been spared the bad English of the Mayor of Montreal.

You will allow me, ladies and gentlemen, to first acquit myself of a certain duty, a pleasurable one, which is to first welcome the members of that veteran Institute of the American Mining Engineers which has for the last 64 years been at work with so much fidelity and zeal, and has accomplished so much for the advancement of the science of mining. We desire to say to them that whatever may be the discord between the two countries, it shall never destroy for our part the good fellowship and social intercourse existing between us. Nothing shall destroy that brotherhood of literary, scientific and intelligent amity.

To the divers associations which have been created within the past few years in the different provinces of the Dominion, we extend with equal warmth a most cordial welcome. They have a large field before them. We have only at the beginning to realize the amount of wealth and resources that good Mother Nature has in store for us. We have only at the beginning to realize, and it can be seen with half an eye, what can be achieved if these resources are properly worked. But that field we know is in good hands. We know that we have active, scientific men who will do all they can, and are doing all they can, to teach Canadians how to work these resources;

H. S. Poole, M.A., F.G.S., Stellarton, President Mining Society of Nova Scotia.

and such good examples have been given us by our neighbors, that I am sure we shall soon be able to follow in their footsteps.

The questions you will have to study, the lectures you will hear, will not leave much room, by the praetical essence of their very nature, for the imagination's play nor the inspirations of poetry. But you are practical men, and you will know how to supplement the deficiency. You have brought with you poetry—not in books, but far better than that—in reality; the poetry of heaven and nature combined! And we welcome that element, that refining and inspiring element, that foundation of what is best in poetry, with—shall I say, even more cordiality and tenderness than we welcome you of the *steely* sex.

I trust sincerely that the ladies may thoroughly enjoy their visit. They have heard, doubtless, of the attraetions of our winter; and no doubt they have already since their arrival experienced in a practical manner one of those attractions—the sting of Jack Frost. For Jack Frost is a true Canadian in the sense that he has a fine appreciation, after his own fashion, of what is lovely and charming and tender. However, though our climate is cold, we shall endeavor to show you that it has not the slightest effect upon our hearts, naturally warm; for they are not cold. We welcome you all; and we trust that when such another Convention is contemplated, the members may be able to look back upon this one, and say: Why should we not go to Montreal?"

Mr. John Birklnbine, President of the American Institute of Mining Engineers, on being called upon by the Chairman to speak, begged to be excused in favor of Dr. Raymond, the Secretary of the American Institute, as he, Mr. Birkinbine, was down to deliver an address later on in the evening. Dr. Raymond, he said, usually spoke for the Institute on these oceasions, and had a speeeh, he knew off by heart.

DR. RAYMOND.—There is one part of my speeeh, Mr. Chairman, ladies and gentlemen, whieh I did not learn by heart; and that is to say that though there have been 64 meetings of the Institu e, the latter is not, as the Mayor supposed, 64 years old. We should certainly grow old very fast in that way. I have been present at 61 meetings, and I cannot count the number of times I have been an officer of some sort in eonneetion with the Institute. It is also my duty to explain that the Institute is not a body having any local habitation whatever; for when we come to meet in Montreal, we do not come as a body of strangers; for the word "American," as applied to our societies, includes alike Canadians and those of us of the United States. Therefore, in coming to Montreal, we simply come, as it were, to our own. And. so from the beginning we have known nothing at all about latitude, nor of that thing we hear so much about—the boundary line. I may be treading on delicate ground when I say "Boundary Line." But, after all, where angels have rushed in, I should not fear to tread. The Mayor of Montreal has hit what I consider to be the truth in this connection, and in all connections where we from both sides of the line come together. So as I have no political ambitions on either side of the line, I may be permitted to say a word or two.

I am going to say in the first place that I do not think that pleasant and agreeable neighbors must necessarily marry. If I had to marry everybody that I ardently admire, there would be an awful breaking up ot domestic ties in the families of members of the Institute of Mining Engineers. I think people can live humanely and affeetionately side by side without thinking always about pulling down the partition. If Uncle Sam had to marry, I should prefer to see him join hands with a rosy, pink and frost-cheeked girl of the north rather than a dusky maiden of the Pacific; but it seems to me that if the United States and Canada were to become one, we—that is the United States—would then have as our nearest neighbor the North Pole; and I think that Canada would be a far more pleasant neighbor. Not that we should not consider all the domestie and internal questions of the future, as well as of the past. But, while speaking frankly, I may say that to me there is a higher view than this to take. For I for one would not tread upon those glorious distinctions which have enriched the past, and given us so many splendid memories. Standing upon this soil of Canada, I cannot forget the Lillies of France; nor can I forget what my countrymen owe to the sturdy Englishmen who crossed the sea, and won for us that liberty which we have always enjoyed at home. The Lillies of France, the Eagle of the Republic, the Cross of St. George, are all essential component parts of the historical, martial and national memories of America. And for my part I care very little—nay, I may say more—I pray to God that the meteor flag of England and the ensign of my country, whose stars bid welcome to the sunrise, may never stand opposed upon any battle field—nay, may never wave over any field of blood; but rather may blend and wax glorious together as the white and more glorious banner of peace and progress, and so set an example to the world. And in that splendid relationship we can move forward with serried ranks to a victory, unstained, irrevoeable, magnifieent, matchless; a victory that shall be celebrated by the glad thanksgivings of earth and blessed by the smile of a favoring heaven.

Dr. Raymond's excellent speech, it is hardly necessary to say, was listened to with absorbing interest, and loudly applauded at its termination.

The President then followed with an address on the "Development of Technieal Societies."

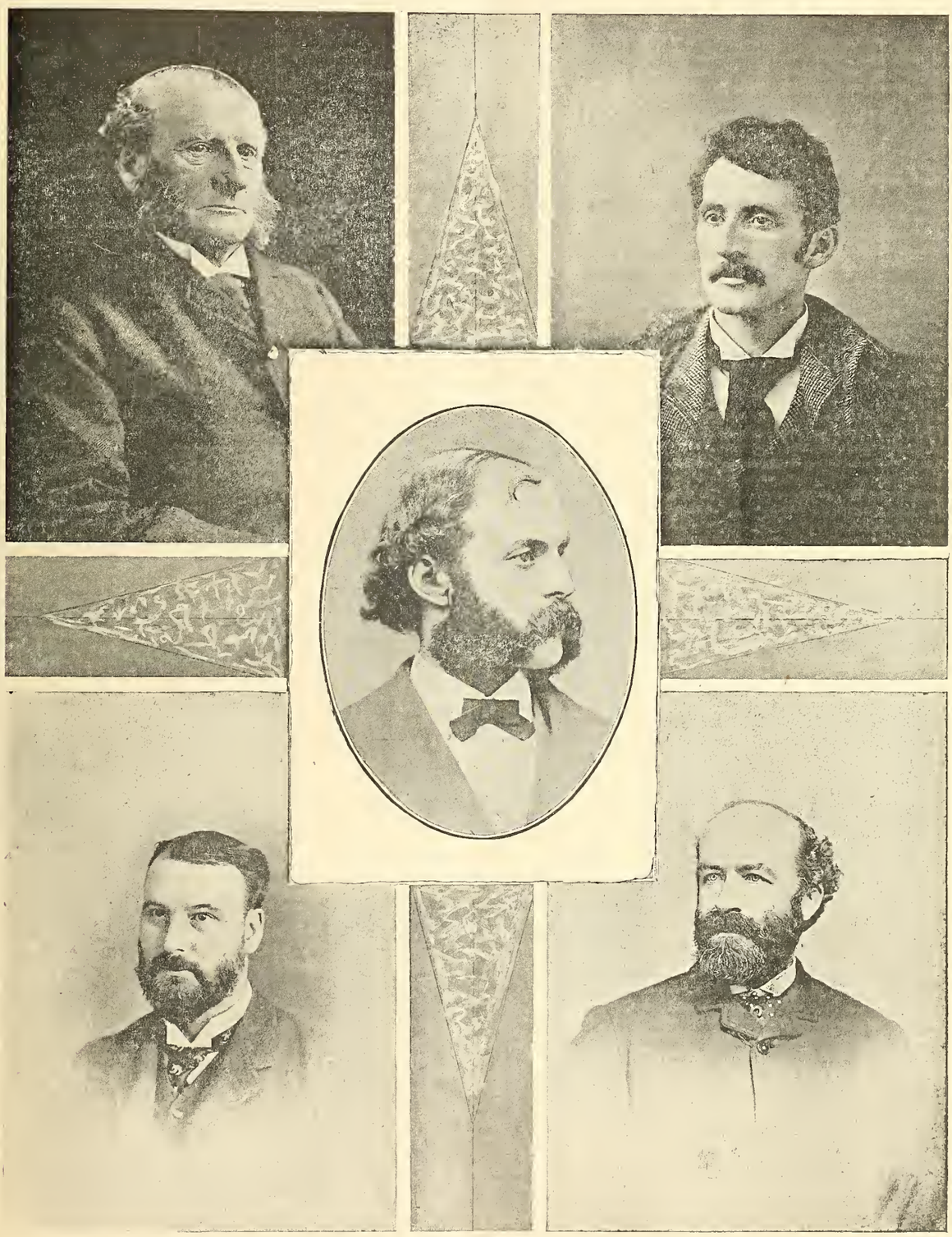
The Development of Technical Societies.

MR. JOHN BIRKINBINE.—Through the partiality of my fellow members, I have been able during seven years service on the Council of the American Institute of Mining Engineers, to note the development of technical societies, a subject which commends itself as an appropriate theme for presentation at the time when relinquishing the office of president, we meet in convention with Canadian teehnical societies. Our next assembly, called at Chicago, at the time fixed for an International Engineering Congress, offers additional reasons for the selection of the topic.

If subsequent statements appear to give to the American Institute of Mining Engineers greater prominenee than other kindred organizations, they may be excused upon the ground of long association with and loyalty to its members, and to a personal knowledge of their work. Besides, data as to growth and development is more accessable, and at a meeting of the Institute, features connected with it may be considered as of greater immediate interest than those affecting other organizations.

The purpose of this address is, however, to use the records of the Institute, as indicating a similar develop-

International Mining Convention.



Hon. George Irvine, Q.C., Quebec, President, Genl. Mining Assn.

B. T. A. Bell, Ottawa, Secretary, Genl. Mining Assn.

Dr. R. W. Raymond, New York, Secretary, American Inst. of Mining Engineers.

A. W. Stevenson, C.A., Montreal, Treasurer, Genl. Mining Assn.

Capt. R. C. Adams, Montreal, Chairman, United Convention.

ment of other technical societies, rather than to claim pre-eminence for any organization; the work of each must speak for it.

Before referring especially to technical societies, a few thoughts may be devoted to the general tendency to form associations at the present time. Organizations may have been formed and are active in every profession and also in all branches of labor, trade, industry, commerce, manufacture, science and art. A record giving a list of such associations or the aggregate membership would be startling, and show how a large percentage of the population of North America is connected with one or more of these, but the figures cannot be even approximated.

The class of associations representing national, state or local trade interests, such as Boards of Trade, Chambers of Commerce, etc., may be used as an illustration. A late report showing that in the United States, there are over 1,100 of these, of which thirty are of national character, and more represent the interest of a State, or of districts including portions of a group of States.

Existing organizations may be divided into many classes, some of which are for mutual benefit in controlling rates, hours or character of labor, or for adjusting compensation paid or received for labor and materials. Others provide stipends for members during sickness or for their families in case of death, and another group seek to control the services of persons entering certain lines of employment, or fix standards for determining the qualifications of such. The proceedings of many associations are carried on in secret, others are more or less open, some use extreme scrutiny as to membership, and others may be included in the class, "omnium gatherum."

In all these forms of organizations, there is some good; any union for mutual advancement commands esteem, but in a number of cases, the better element of the membership is hidden or over-ruled by selfish purposes controlling the administration of affairs to the disadvantage of the mutual or progressive features. Probably no better evidence can be offered of the power of a few men to control others, or of the blind obedience of the masses to arbitrary dictation by leaders, than is presented by some of the popular trade organizations.

The class, however, in which we are especially interested includes those institutes or societies where professional and business men, recognizing the value of the interchange of ideas, assemble to discuss problems and processes, and while no comparison of the relative merits of various forms of organizations will be made, it may not seem ungenerous or exhibit vanity, to claim for those whose primary objects are the investigation and discussion of subjects in which the members are interested, and the publication of the proceedings or transactions for the general advancement of a special trade or profession, as being in the foremost class of associations.

The number of different societies which may be properly in the special class mentioned, is greater than is generally believed; for, if from the list of all kinds of associations, there were eliminated the social or secret organizations, all others, which in any way attempt to affect or control the rates of wages or the hours or kinds of labor, or to fix or adjust prices for commodities, all strictly commercial organizations, and all those which offer any money benefit to members or their representatives, or those formed to advance certain sects, parties, nationalities, or classes, there will still be found a considerable number of organizations representing constituencies of many thousands joined together for the purpose of mutual advancement and for improving special professions or businesses in which the members are engaged, by the interchange of ideas, and dissemination of thoughtful papers and discussions.

Diversified business or professional interests encourage a considerable number of persons taking part in several associations, more or less closely allied, thus forming many powerful organizations of manufacturers engaged in special lines, and also of men following various professions. Thus, the legal fraternity presents a liberal contingent of associations representing that branch of professional work. Officers and members of various churches are formed into clubs, independent of synods, classes, assemblies, etc., and geologists, chemists, journalists, architects, artists, and engineers each have special organizations. It is to the last named group that attention is particularly invited.

Nearly twenty-two years have elapsed since the American Institute of Mining Engineers was organized, and its score of original membership has increased, the rolls now containing nearly 2,400 names while the necrological data preserved in our records calls attention to the fact that over two hundred late members of the Institute have finished their earthly work and gone to their reward. In this list of the departed, are names of men who have done valiant service in the interests of mining and metallurgy, whose work lives and will live, and whose record is familiar, not only in their own, but in foreign countries.

Prior to to the organization of the Institute, there was in the United States, but one national engineering society, and but few local organizations devoted to this profession, while the list of organizations in foreign countries was small. There are to-day in the United States, four engineering societies of national character, with memberships as follows:—

American Society of Civil Engineers, organized 1865, membership of 1,650.

American Institute of Mining Engineers, organized 1871, membership 2,400.

American Society Mechanical Engineers, organized 1880, membership 1,650.

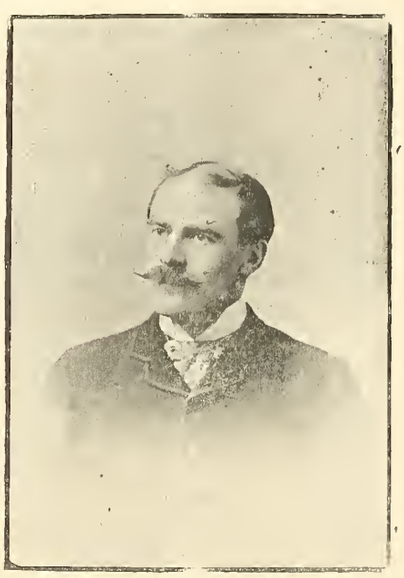
American Institute Electrical Engineers, organized 1886, membership 650.

The scopes of these national associations vary to suit the purpose of organization, and the policy pursued in each differs from that of the others, being presumably adapted for the membership, which has in each extended beyond the limits of the United States, embracing many of the prominent engineers in Canada, Mexico, and in foreign countries.

Therefore, the engineering profession in the United States is well equipped with national associations, in which those interested in any particular branch, or who desire to follow a special line of inquiry, meet with others having similar purposes for the reading of papers, or for the discussion of topics in which they are mutually interested; or if prevented from attending meetings, members can peruse the transactions as issued, from which information as to what has been presented and discussed is obtainable.

There are also national associations closely allied to engineering, which have obtained prominence and rendered much service to the members, or to the business represented, as well as to engineering; at the meetings of which papers are presented and discussed and publication made of matters of interest. Among such, are the associations of master mechanics, of railroad superintendents, car-wheel makers, car builders, founders, boiler makers and others.

To the national associations are to be added a score of local or district engineering societies or clubs, some of which have 500 names on the roll of members, possess excellent libraries, issue proceedings regularly and occupy commodious quarters in which the social intercourse of engineers is encouraged, as an incentive to professional advancement.



W. Hamilton Merritt, A.R.S.M., Toronto, Chairman, Ontario Committee.

The present meeting indicates that the Dominion is alive to the necessity of technical societies, for the Canadian Society of Civil Engineers, both by its membership (of 700) and its record is given a prominent place among engineering organizations, and the opportunity is cordially embraced of meeting with and learning of the General Mining Association of Quebec, the Mining Society of Nova Scotia, the Asbestos Club, and all other Canadian societies, who now meet in convention with the American Institute of Mining Engineers.

It is unnecessary to trace the history of foreign associations of engineers, beginning with the social club claimed to have been organized by Smeaton about 1771, nor to mention the number of associations devoted to engineering or kindred sciences, as given in the "Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland." But in view of the courtesies which in late years have been exchanged between European and American engineers, the active interest in technical organizations in Europe will be recognized by reference to a few of the most powerful and well known societies.

The Institute of Civil Engineers of Great Britain reports a total of all classes of members exceeding 6,000.

The Societé des Ingénieurs Civils, France, has over 1300 members.

The organization of Civil Engineers in the German Empire reports some 6,000 members on its roll, and the Mechanical Engineers have an association of about the same size.

The Iron and Steel Institute of Great Britain number 1,500.

The Verein Deutcher Eisenheutenleute has over 1,000 members. In addition there are societies in Russia, Sweden, Australia and, to us, other remote parts of the world.

It is expected that delegates from most of these associations will take part in the Engineering Congress at Chicago, in August next; an occasion which should do much to advance the fraternal feeling and the professional interests throughout the world.

The numerous technical and semi-technical societies mentioned, have not grown nor are they sustained merely by the social features they offer, pleasant as these may be; their formation was encouraged by a desire to interchange ideas, and they are maintained because of the benefit to be derived from the papers presented and discussed.

A past president of the British Iron and Steel Institute refers to the visit of that organization to the United States in 1890, with sentiments which may properly be employed to express the purpose and results of meetings which various associations have held and will hold in different portions of the world, and which may certainly be quoted on the present occasion:

"These expeditions, through which we meet eye to eye, and voice to voice, our friendly competitors, to discuss the interests and the scientific aspects of the industry which absorb us, have been of great personal and national benefit. It is thus we learn how much has been accomplished by persistent and intelligent labour, how much remains to be achieved, and how by free exchange of ideas and of productions, friendly understanding is promoted and personal acquaintance is built up."

Those who have followed the growth of the American Institute of Mining Engineers, recognize its work in the contents of its transactions, but trace its influence, and that of kindred associations, in the advanced work in laboratories and engineering offices, in the growing appreciation of technical education, in improved methods of mining and metallurgy, and in a better understanding of geology, chemistry and other sciences.

Smilarly much of the progress in applied science is directly traceable to other technical societies, and every branch of industry shows the good result of co-operation by those interested in special investigations.

In reviewing the history of the institute, it will be profitable to note the advances made in some special branches in which its members are directly interested; for the years covered by its life have been marked by great progress in the quantities of mineral won, metal produced and manufactured, and of a very great decline in the prices which the products of mine, furnace or factory command. Ample allowance may be made for the demands of a rapidly augmenting population, or for Governmental encouragement of industry, and yet the claim that a great part of this progress, both as represented by the increased production and decreased cost, is due to the development of technical societies, must be recognized. It is certain that in a number of known cases, men have been better equipped and better able to contend with the problems before them, because of their connection with technical societies, bringing to them the papers read and discussions had thereon, and much is undoubtedly due to close personal acquaintance and friendship resulting from association. A few facts selected from many which could be mentioned illustrate the progress made during the existence of the American Institute of Mining Engineers 1871-1893, and while the data presented refers to the United States, similar results, although possibly less pronounced in some cases, could be obtained for other countries.

The annual output of iron ore has increased from three millions to over sixteen million gross tons, making the United States the largest producer of this mineral, while for the past decade nearly a million tons of foreign iron ore per year found a market in the country. When the Institute was organized the Lake Superior iron district was producing slightly over eight hundred thousand tons of iron ore per annum and had up to that time shipped an aggregate of four million tons; it has now reached an annual output of over nine million tons, and in the twenty-two years existence of the Institute, it has furnished a total of seventy million gross tons. One and two-third million gross tons of pig iron (a) was the output of the blast furnaces of the United States, at the birth of the Institute, last year shows a total of over nine million gross tons (b).

New districts have been opened, and sections which supported iron industries of but small capacity, have grown to be large producers. In the early days of this society, the pig iron output was obtained from a number of small furnaces, and about one half was made with anthracite coal, three tenths with bituminous coal and coke, and one fifth with charcoal. Now three-quarters of the pig iron is produced with coke, the balance being divided into about the same proportion as in 1871, between anthracite and charcoal, but the quantities of each has been greatly increased, and owing to improved construction and methods, a smaller number of furnaces produce the larger quantity of pig iron.

The steel industry has, in twenty-two years developed from an annual output of seventy thousand gross tons to one of four million gross tons (a). When the first meeting of the Institute was held, the Bessemer steel industry was making its initial impression on this continent, while open hearth steel manufacture was a struggling infant. The former has advanced from an annual output of thirty-five tons to one exceeding four million tons (b) and while the latter has grown from three thousand tons to nearly six hundred thousand tons per annum (c).

In an interesting monograph, entitled "Twenty Years of Progress in the Manufacture of Iron and Steel in the United States," Mr. James M. Swank says (d): "It

(a) 28 per cent of what Great Britain then produced.
(b) A product of pig iron 20 per cent. greater than that of Great Britain in the same year.
(a) Bringing the United States in advance of the magnificent industry of Great Britain.
(b) A product nearly double that of Great Britain.
(c) This quantity is less than one half of the amount of open hearth steel made in Great Britain.
(d) Mineral resources of the United States 1891.

seems almost incredible that as late as 1860 this country should have produced only 11,838 tons of all kinds of steel; yet these are the official government statistics. Our magnificent steel industry is virtually therefor the creation of the present generation." And yet with all these advances in the steel industry, with the displacement of iron rails by steel rails, the rolling of iron in all shapes has increased.

This inquiry might be carried further into the manufacture of rails, plate and bar iron and steel, nails, the construction of metal bridges, ships, locomotives, cars, machinery and the great works filled with superb appliances for fabricating them. But this is not the place for details, and further reference to the production of iron or steel will be confined to the statement that a ton of pig iron, of bar or plate iron, or a keg of nails, now sells at from 33 to 40 per cent. of what was received for it in 1871, while the price of steel rails is but 25 per cent. of what these commanded at the date mentioned.

In 1871 the greatest depth which had been reached in any of the copper mines of the Lake Superior region approximated 1,000 feet, and the price per pound for copper was thirty cents and upwards. It was then impracticable to work any of these mines which did not produce a mineral carrying 2 per cent. or more of copper. At the present time in that district, mines are 4,000 feet deep, and although copper sells for twelve cents per pound, mineral yielding six-tenths of one per cent. of copper is raised from a depth of 2,000 feet, crushed, jigged, delivered at refining works and sold at a moderate profit on the operation.

In the interval, the magnificent copper deposits of Montana and Arizona have been developed, the former taking first place as a producer, with the Lake Superior region second, and the total production of the United States of three hundred million pounds of copper, is now five times what it was in 1871. In addition the important discoveries and exploration of the copper and nickel deposits in the Sudbury district of Ontario, Canada, which have justly attracted widespread attention, deserve notice as factors materially influencing the output of copper.

The life of the Institute has seen the development of the heroic method of working gold gravels by hydraulic mining and also its decline, owing to legislation prohibiting tailing into the streams of California, which reduced the output of the gold some $10,000,000 per year. Although the hydraulic system was used in 1852, it was not until 1870 that the first large "inverted siphon" was introduced in the gold gravel section of California, and in 1876, the "deflector" was added to facilitate the handling of the "little giants." Under favorable conditions gold gravel has been treated by the hydraulic system for three cents per cubic yard.

In the treatment of gold ores by chlorination, advance has been made both in reducing the cost and working to a close extraction. Barrel chlorination has supplemented vat chlorination, late cost sheets showing favorable results.

The liberal introduction of vanners, and the consequent saving of the pyrites, which nearly always exist, may be cited as another important change.

Pan amalgamation for silver ore has improved and cheapened and silver lixiviation has made important advances, while silver lead smelting has been greatly developed. In 1871 there were few smelting plants west of the Mississippi River. Now magnificent smelting plants are operated at Denver, Pueblo, Omaha, Salt Lake City, Leadville and elsewhere.

The so-called "practical" smelter has given way before the chemist and the experienced lead metallurgist. Cleaner and better work is now done, lower grade lead ores are utilized than formerly and lead slags made in 1878 are now being re-worked.

Direct matte smelting is another innovation, and while much has been done in concentration, this field is still very promising. In the time under discussion, the annual output of silver in the United States increased in value from $16,000,000 to $75,000,000.

In a former address attention was drawn to the growth of the coal industry, it is only necessary therefore to refer to the distribution and the production of mineral fuel, increasing five-fold since 1871 and reaching an annual total of one hundred and fifty million tons, of which practically one-third is anthracite, and two-thirds bituminous, while in 1871 nearly equal portions of the two kinds of fuel were mined.

In the interval of time covered by the records of the Institute, power drills and high explosives have become necessities of mining, electricity has risen from a laboratory experiment, or a medium for operating telegraph lines to universal usefulness for light, and in many cases for power, and aluminum has entered the list of practically useful metals.

The above is a glimpse we obtain by looking backward, and if as has been claimed, much of this progress mentioned may be properly credited to the influence of technical societies, a glance forward may be permissable, for the end is not yet, and further increase in the number, membership, and importance of technical associations, may be expected.

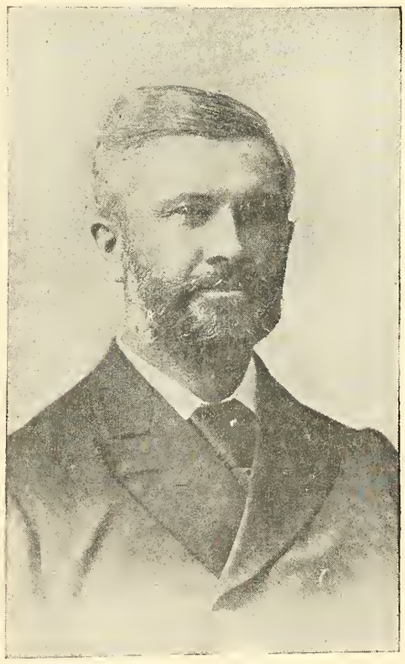
Each society will in generous rivalry employ the best for securing the highest results to be derived from organization. In view of the past and recognizing that but a small proportion of those connected with any technical society can attend its meetings, the line of advance seems to be in the direction of maintaining a high standard for the transactions.

The purpose of meeting together is but partially fulfilled by the pleasures of personal intercourse, by warm welcomes and generous entertainment, by visits under advantageous conditions to industries or mines, and by the reading of papers; for there is much profit in full discussion of many of the topics presented.

The discussions which should follow the presentation of most papers, make the contributions more valuable, and as a rule bring out information which the original does not contain. The papers are thus made more useful, not only by reason of these additions, but also because discussions upon the statements of the writers give to these greater weight. If statements are unchallenged in such discussions, the conclusions ordinarily reached would be that the premises upon which they were based are sound. On the other hand, discussions which might probably appear to challenge the data presented in papers do not, necessarily, condemn them, but may cause them to be so modified as to be of greater value than as originally presented.

There may be either the oral or written discussion. Some organizations follow the practice of printing papers in full prior to the meetings, and reading the papers in abstract, making the discussions the prominent features. Others have papers read in extenso, followed by oral debate but the discussions are often less complete than is desired. The time allotted to sessions seldom permits of reading long papers, and allotting unlimited hours to the discussion, but in many contributions presented there are some features which need not, and others which should not be read in the sessions, as these would be tiresome if read in detail. Analyses, tables, statistics, etc., placed upon black boards, issued in proof form, or exhibited by a diagram or by lantern slide permit listeners to grasp them more readily and considerable time is saved.

A fair proportion of the papers presented before technical societies, are not such as to invite debate, but those offering points for discussion should be discussed, and if members who attend the meetings are prepared to respond promptly, confining the discussions within limited time and closely following the scheme of the papers, a large amount of valuable information can be imparted. The character and extent of discussions lies not with the officers of the organization, but with the members and the



A. Blue, Toronto, Director of Mines for Ontario.

subsequent value of the publication is likewise dependent upon the promptness and care which characterizes the revision of the subject matter, by individuals who participated.

Believing that future advances in technical societies will be influenced by the publication of well digested monographs, and by liberal encouragement of discussions upon the papers read, it seems to be better policy to print a small number of papers fully discussed, than to merely issue a large amount of material offering controversial data without discussion.

Oral discussions offer the advantage of being more attractive and interesting to those attending meetings than the written discussion, the latter is generally more carefully prepared than the extemporaneous statements made when the members are in convention, but there are points often omitted in written discussion which would be brought out under the spur of personal contact, and members are less likely to take part in the written than in oral discussions.

The late Hon. James G. Blaine, writing on the growth of reports of Congressional debates, makes some interesting statements, and while these are quoted, the intention is not to intimate any close analogy between the Congressional debates and the business of the technical discussions which enliven the meetings of the organizations specified, but rather to advocate initial oral discussion, supplemented by written data.

Mr. Blaine says:

"In the beginning of the Government, and for many years thereafter, on every important measure that came before Congress of the United States, on the expediency of which the members differed in opinion, there was an actual debate, in which positions were affirmed and contested with off-hand speech. In every conflict of this kind the members of Congress were, as a rule, in their seats, many taking part, and the mass so interested as to sit continuously through the debates." After illustrating how the habit of speech has greatly changed and the general use of manuscript discussions read to many vacant chairs, extending in one house of Congress to giving permission to print speeches not one word of which has been delivered, Mr. Blaine mentions the Fiftieth Congress, which lasted from March 4th, 1887, to March 4th, 1889, and says:

"In an uneventful period, with nothing specially to excite or disturb the country, the number of pages filled by the proceedings of a single Congress is greater than during the whole period of the Civil war, with all its mighty issues at stake."

To make a comprehensive and most suggestive comparison, he states that "the Congressional reports for the last twenty-five years contained in volume of printed matter, 60 per cent. more than all the reports for the seventy-six years from the inauguration of Washington in 1789 to the close of the Civil War in 1865."

It may be unfair to compare political debates and technical discussions, and the above is not introduced with any such object. The extracts are merely quoted to indicate the interest which attaches to oral discussion drawing to the meetings members anxious to hear or to participate, and eliciting a variety of opinions which would not be obtained under other circumstances. Such interest once excited may draw into the discussion persons who are not present, and thus gain the advantage of subsequent written discussions.

The papers presented at the meetings of technical societies and the discussions on these papers supply a record of progress, such as would be impracticable to obtain from any other source, and place in the libraries of members a fund of knowledge, which otherwise could only be secured by liberal personal outlays for expensive books. Without in any way detracting from the value and importance of works issued upon technical subjects, it may be safely asserted that it is impossible for special treatises to be as closely up to the times, as the transactions of technical societies, and thus each member of the various organizations can have an encyclopedia library as part compensation for his outlay in support of the society.

Another important influence exerted by papers and discussions is in the publicity given these by the trade and technical press. It has been claimed that members of engineering associations devote their energies to papers to be read before the technical societies which otherwise would be contributed directly to the technical press, but it is questionable whether in this particular the press at large is not the gainer, although possibly a limited number may lose special contributors; for the incentive to submit papers for the criticism of fellow members increases the number of available contributors, and educates many to write for publication who would otherwise be silent.

My effort has been made to show the remarkable development of technical societies, giving some reasons therefor, and the claim has been made, which seems to be within reason, that the broader sentiment which has caused engineers to unite in associations, is responsible for a good share of the industrial advance which has been made. The thoughts as to the future increase and the most advantageous means of obtaining from these associations the full value which they offer, may be open to criticism, but they are presented after a careful review of the work of numerous engineering societies, backed by a personal knowledge of some most important results which have followed the presentation and the active discussion of papers presented.

At the conclusion of Mr. Birkinbine's address the visiting delegates were presented to His Worship the Mayor and Madam Desjardins. Then the band played, and a large space was cleared in the centre of the hall, where the "muse of the many twinkling feet" was hailed the supreme goddess of the moment, and those who could not dance—where will you go that you do not find the man who does not dance?—looked on with envious eyes; for the music was positively, and the ladies superlatively sweet.

And after that, it may possibly be necessary to add, *all* the men went to bed; some to dream of the hard nuts to crack with the hammer of science upon the anvil of common-sense on the morrow, of the papers innumerable and the probable questions still more so; but all such dreamers more or less to have their scientific nightmares put to flight, and their sleep blessed by the vision of a face or the memory of a feminine figure drifting through the land of sleep to the air of a Strauss waltz.

Proceedings of the Sixty-fourth Meeting of the American Institute of Mining Engineers.

The opening Session took place on Wednesday morning, 22nd instant, in the Physics Building, McGill University, Mr. John Birkinbine, President, in the Chair. The following as a synopsis of the proceedings at this, and at the meetings held in the afternoon and on Thursday morning.

Dr. Raymond, the Secretary, read the report of the Council. The membership has had a net increase of 154 during the year, and the total is now 2,376, as follows :

Honorary members	15
Foreign members	38
Members	2,136
Associates	187
Total	2,376

The total receipts were $26,595, and disbursements $23,131, leaving a balance of $3,483. The Council, for the Institute, has accepted the charge of the two divisions of Mining and Metallurgy of the International Engineering Congress, which will be held the first week in August, at Chicago, and these will constitute regular meetings of the Institute.

The first paper presented was by Major Powell, on the "Geological Survey of the United States," which was read by Mr. Hayes. For a geological map there must be: 1, A base map on which to represent the rock formations; 2, a systematic classification of the formations; and, 3, a system of conventions for representing these formations on the map. One of the first things to be done was to arrive at a systematic classification of rocks, and scheme of representing them. The system adopted by the Geological Survey was described, with notes on the classification. Sections are of most value if printed on the body of the map instead of in the margin; but as this would complicate the colors and symbols, special sheets of sections, topography, surface deposits, etc., are issued. The maps are mainly on a scale of 1 inch to the mile, and are published as atlas sheets. About 12,000 square miles have been covered. The total cost, including engineering, is given as $4 per sq. mile for the topographic survey, and $7 to $8 per sq. mile for the geologic survey. Dr. Selwyn, Director of the Geological Survey of Canada, referred to the work and systems in Great Britain and Canada, the latter being hampered by the very small amount of money available, only $60,000 as compared with $300,000 in the United States. It would be absurd, he thought, to attempt to imitate on maps the color of the rock formations, but he thought it desirable to have some more uniform representation. He also believed in the use of lines and letters as well as colors. Dr. Raymond agreed with Dr. Selwyn as to the desirability of a uniform system of representation, and he did not want the United States standing out obstinately for its own system. Dr. Day, of the U. S. Geological Survey, said the matter in hand had to be published, and they tried to use the best system available.

A paper on "The Greene-Wahl Process for manufacturing Manganese and Alloys of Manganese free from Carbon," was then read by Mr. F. Lynwood Garrison. Samples were exhibited having an average composition of 96·5 manganese, 2 iron and 1·5 silicon, the metal being dense and homogeneous, with a steel-gray color and reddish-bronze tint. It has a pungent odor, attributedto hydrogensilicide, has no tendency to oxidize and disintegrate in moist air, as does manganese containing considerable carbon, and it has an average specific gravity of 7·32. In the discourse, reference was made to an electric smelting furnace, and Dr. Raymond stated that the minimum cost of prodtction of aluminum by any process now known would probably be 18 to 20 cts. He did not think the adoption of water-power would reduce this, as where coal is cheap the steam engine is still the cheapest form of power.

Prof. W. B. Blake then read abstracts of three papers, dealing with lead and zinc ores : "The Mineral Deposits of South-west Wisconsin," "Separation of Blende from Pyrites," and "A New Form of Furnace for Roasting and Oxidizing Ores." The furnace is a revolving table formed of a series of circular terraces, and is charged from the top, while the fire passes across the chamber. The ore is moved from step to step by means of "plows" set in the roof of the chamber, and by this method the ore is thoroughly subjected to the heat, and is nearer the fire just before its discharge. Superheated air is used in the furnace, and the table makes about ten revolutions per hour.

At the afternoon meeting Mr. R. H. Richards read a paper on the "Prismatic Stadia Telescope," being a continuation of a former paper, and giving details of the rods and targets, and also of a self-spacing target.

Mr. A. J. Rossi then read an abstract of a paper on "Titantiferous Ores in the Blast Furnace." These ores are generally low in phosphorous and sulphur, and many are very rich in iron, even when high in titanic acid. Particulars were given of numerous tests, showing that good pig iron can be successfully made, and that this ore may become more generally available. "We do not claim," said Mr. Rossi, "that everything has been settled definitely by this experiment. But it has been possible to obtain from ores containing some 20 per cent. of TiO_2, in continuous manner, under the conditions of working of a furnace and on a scale certainly unfavorable to good reduction of the ores and a proper distribution of heat in the different parts, both slags and pig-iron. The slags showed good fluidity and fusibility, though containing, some, 25 TiO_2 to 22 SiO_2; others 40 TiO_2 to 22 SiO_2, and some 35 TiO_2 to 14 SiO_2, with magnesia, alumina, and lime as bases. No other addition of fluxes to the ores and coke was required than limestone (dolomite and calcite mixed, pure lime having been once resorted to for want of calcite); and the consumption of materials (certainly of flux and even of coke, considering the dimensions of the furnace) was fairly economical for a 51 per cent. iron-ore, viz., ore 50, coke 50, stone 21. At the same time a mottled or mottled-white iron was obtained which was considered as very strong by some founders, and which we offer for examination." Prof. Harrington said that experiments had been made with Canadian ore containing 48% titanic acid, but the results had not been successful. Dr. Egleston said that in testing an ore for phosphorous he had found 7% of titanic acid, but no phosphorous, and some furnaces may be using titanic ores without knowing it. Another member stated that titaniferous ores are successfully worked in Sweden.

A paper on "The Biwabik Iron Mine," by H. V. Winchell and J. T. Jones, was read by Mr. Winchell.

R. G. Leckie, Londonderry, N.S., Vice-President, American Inst. of Mining Engineers; Vice-Pres., M'ng Soc. of Nova Scotia.

This is one of the newest mines of the Mesaba Range, and while no ore has yet been shipped a considerable amount of money has been spent in thorough exploration. The working will be by stripping and open pit-mining. There will be about 2,800,000 cubic yards of glacial drift removed to prepare the deposit for working, and the deposits are about half a mile wide and 100 ft. thick in places. The grades of the steam-shovel tracks will be 1½°. The ore is soft, and averages 63.25% metallic iron and .036 phosphorus. The steam shovels will dig the ore and load directly on to the cars. The stripping will be dumped by side dump cars. Dr. Raymond said that the topographic and other conditions are so good that probably the cost will be only about 16 cts. per ton for stripping, mining and loading. Mr. Birkinbine referred to the recent and rapid developments of these Minnesota iron deposits, and stated that the men who developed the Vermillion Range, passed over the Mesaba Range, which is now being developed.

At the morning meeting on Thursday, Feb. 23, Mr. R. H. Richards read a paper on "A Graphical Slag Calculation." This was followed by Mr. E. E. Russell Tratman, of New York, with a paper on the subject of

Unfreezable Dynamite,

The use of dynamite in cold weather is attended with some difficulty, owing to the freezing of the material and its consequent liability to fail to explode when the fuse is fired. With proper methods and care the dynamite can be thawed with reasonable safety, but numerous accidents occur (more than get reported in the public press), due to carelessness in the operation and to the treacherous nature of the material, or a combination of both conditions. Dynamite will stand treatment at one time which at another will result in explosion. An expert on explosives says that the most dangerous means of thawing cartridges are ingeniously devised by ignorant laborers; baking, boiling and toasting being favorite methods, while at a stone quarry, in one instance, an apparatus was arranged for steaming cartridges over a pot of boiling water. In this latter case the nitro-glycerine leaked through the canvas cover and settled on the bottom of the pot, with the result that an explosion occurred, the water acting as a tamping to the charge.

The fact that small quantities of explosives containing nitro-glycerine will burn quietly and without explosion if ignited by direct contact with a flame, has led to the dangerously mistaken reasoning that merely heating the explosive can produce no ill effect. If a dynamite cartridge is ignited or placed in a fire it will probably burn harmlessly away, but if placed on a stove or in an oven, and gradually heated to its exploding temperature of 350 to 400 F., a violent explosion is almost certain to result, while before that point is reached the dynamite will become extremely sensitive to shock.

In England alone, from the beginning of 1872 to the beginning of 1890, there were reported 63 accidents due to improper thawing of dynamite, by which 50 lives were lost and 76 persons injured.

Reference may here be made to the explosion of dynamite, December 28th, 1892, in a thawing apparatus at the works for commencing the Brooklyn end of the proposed New York and Brooklyn tunnel, by which four persons were killed and about twenty injured. According to report, the thawing was done by placing the cartridges on shelves in a chamber six feet square and eight feet high, heated by a coil of steampipes.

An unfreezable dynamite invented by Liebert, a German, has been used to some extent in Europe, and has been favorably reported upon by chemists and experts in explosives, and it would appear most advisable to test its practical efficiency in this country. The dynamite is made in the usual way, but its composition includes a chemical (isoamylic nitrate), by which its freezing point is lowered from 40° above to 50° below F., while the explosive power is slightly increased and the sensitiveness to concussion slightly decreased. This dynamite, it is claimed, is not effected by damp; it may be kept for considerable time without deteriorating or losing its special properties, and its cost is little, if at all, in excess of that of ordinary dynamite. It is patented in the United States. It certainly seems that if there is a reliable dynamite, unfreezable; at very low temperatures, and procurable at reasonable cost, it should find a field for introduction in the United States and Canada, and that steps should be taken to insure its introduction, in the interests of life and property.

In the discussion several methods of thawing dynamite cartridges were referred to, but it was shown that they do not provide for carelessness on the part of the laborers who use them. Mr. J. T. Jones described an apparatus for thawing cartridges, consisting of a tin box with tubes, like a tubular boiler; the box is filled with water and heated by an ordinary lamp, and the cartridges are placed within the tubes. Mr. M. Penhale had utilized the exhaust steam of an engine for heating a chamber in which the cartridges were placed. Mr. W. B. Phillips did not believe that there was ground for believing that that seepage of the nitro-glycerine would occur in cartridges, and he had opened and ground up a number of cartridges without finding any evidence of such seepage. With Rack-a-Rock the oil and the cartridges are kept separate in winter until the latter are to be used.

Dr. R. W. Raymond said that rackarock has a strong odor which affects the men, and he had had to give up using it. He thought there was no doubt that seepage of the nitro-glycerine frequently occurs, and is a great source of danger in the use of dynamite. As this occurs largely when the cartridges are being thawed, an unfreezeable dynamite would greatly reduce the danger. As to thawing apparatus, while many safe arrangements may be devised, there is no guarantee that they will be carefully or properly used, as a careless laborer in a hurry to thaw out some cartridges, may disregard all precautions. Prof. W. P. Blake stated that in a case of his own experience the cartridges were placed on racks in a cabin, where they were thawed, but that an explosion occurred owing, it was supposed, to some of the boys sent to fetch cartridges finding them not ready for use and lighting a fire to hasten the thawing. Mr. Woodworth said that in a dynamite storage room one box was left standing on end, and the glycerine seeped out from the cartridges and saturated the wood. Mr. Tratman referred to the use of a double box, with manure packed in the surrounding space, for storing dynamite in cold weather, as used in the Croton Aqueduct. At the works of the Londonderry Iron Co. (Nova Scotia) a double box with mineral wool packing is used to store the thawed cartridges. Mr. J. F. Torrence said he had used the ordinary warming apparatus consisting of two tin boxes, one within the other, with hot water in the space between them, the cartridges being placed in the inner box, but he had found an oily film settle on the bottom of the box, being seepage from the cartridges. He thought many accidents were due to imperfect combination of the nitro-glycerine with the dope.

Third Annual General Meeting of the General Mining Association of the Province of Quebec.

The third annual general meeting of the General Mining Association of the Province of Quebec was held in Lecture Room B., Physics Building, McGill University, on Wednesday, 22nd February. The Hon. George Irvine, Q. C., (Johnson's Company) Quebec, President, in the chair. After the presentation of the Treasurer's and Secretary's reports, which were unanimously accepted, the following officers and council were elected for the ensuing year: *President*: Hon. George Irvine, Q. C., (Johnson's Company) Quebec; *Vice-President*: Capt. R. C. Adams (Anglo-Canadian Phosphate) Co. Montreal; Mr. John Blue, Eustis Mining Co.) Capelton, Que; James King, M. L. A. (King Bros.) Quebec; R. T. Hopper, (Anglo-Canadian Asbestos Co.) Montreal. *Council*: L. A. Klein, (American Asbestos Co.) Black Lake, Que; J. Burley Smith, (British Phosphate Co.) Glen Almond, Que.; George E. Drummond, (Canada Iron Furnace) Montreal; F. P. Buck, (Dominion Lime and Marble Co.) Sherbrooke; His Honor Judge Dugas, Montreal; S. P. Franchot, (Emerald Mining Co.) Buckingham; W. H. Irwin, (Anglo-Canadian Asbestos Co.) Montreal; John J. Penhale, (United Asbestos Co.) Black Lake; Col. Lucke (Beaver Asbestos Co.) Sherbrooke. *Treasurer*: Mr. A. W. Stevenson, C. A. 17 St. John St., Montreal; *Secretary*: B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa. The meeting then adjourned until Friday 23rd inst.

The Duty on Mining Machinery. A safe building for the housing of the Geological and Natural History Survey Museum an urgent necessity.

These were in the main the subjects for discussion at the adjourned meeting of the General Mining Association of the Province of Quebec which was held in the New Club Room, Windsor Hotel, Montreal, on Friday, 23rd February. There was a large attendence of members. Hon. George Irvine, Q. C. presided.

MR. B. T. A. BELL.—One of the resolutions left over from the united meeting yesterday was that relating to the customs tariff on mining machinery. As you know the Dominion Government with the object of encouraging the development of our mines amended the tariff in 1890 so as to admit all machinery for mining purposes of a class or kind not manufactured in the Dominion free of duty. The period was for three years and expires, I think, next month. The Government has again renewed this provision for a like period. The Act is in the main liberal, but difficulty seems to have been experienced in its interpretation at some of the ports of entry by the collectors. While in several districts no difficulty has been experienced in passing mining machinery in free of duty, at others the duty has been enforced on machinery which distinctly was not made in Canada. The collectors seemingly were not instructed what class and kind of machinery should come in duty free. It has been thought that some representations might be made to the Government on the subject.

CAPT. R. C. ADAMS.—This is one of the questions I desired to speak about As it is the law is a perfect farce. I enquired, when in British Columbia, how it worked there and found that it created a great deal of bother. An importer brought in some piece of machinery which the collector often held for duty pending investigation, and then as likely as not some country blacksmith was found to claim that he could manufacture the machinery. I would like to see this association, now that tariff reform seems to be in order, make some expression of opinion on the subject and not be content that the paltry concessions given us be continued.

MR. J. BURLEY SMITH—The mining industry is quite as important, if not more so, than any of our other industries, and it seems to me an unwise policy to hamper its development by any tariff restrictions. At present we are only partially relieved of the duty. I refer to the stipulation in this Act whereby only machinery that is *not* manufactured in Canada shall be admitted duty free. It opens a question as to what machinery is free. For instances while rock drills as *a class* are manufactured in Canada, only two particular *kinds* are made—the Rand and Ingersoll. Yet in Europe at the present moment there are actually 34 distinct types of rock drilling machines, some of which contain improvements which were not even dreamt of at the time the Rand and Ingersoll-Sergeant were patented. Now does the law permit me to import any of these other *kinds* of drills duty free?

MR. B. T. A. BELL—Certainly; I do not think there can be any doubt about it. The Government provides you with a form of declaration in which you simply swear that the machine you are importing is of a class and kind not manufactured in this country, and the collector is bound to pass it. The law is good enough of itself; it is its operation at some of the ports of entry that is defective.

MR. S. P. FRANCHOT—According to the Canadian Patent Act it is necessary that the machinery—in order that the patent may be perfected—shall be manufactured within two years from the date of the patent. I am in favor of a deputation waiting upon the Comptroller of Customs and asking that the collectors be specifically instructed what machinery is entitled to free entry, and that the most liberal construction be placed by the collectors in their interpretation of the law.

MR. J. BURLEY SMITH—Do you not think that the fact of the importance of the extension and development of the mineral industries, we might with reasonable assurance ask the Government to take off the duty *in toto?*

CAPT. ADAMS—Hear! Hear!

MR. B. T. A. BELL—The Government is perfectly liberal, but it must be expected to give reasonable protection to our own manufacturers.

MR. W. H. IRWIN.—Mr. Bell's conclusion is that the Act is liberal. The experience of my company has been different. The meaning of the Act is vague and ambiguous—it is so loosely worded that almost any thing we use in asbestos mining can be construed by the collector to be either directly or indirectly manufactured in Canada. Can Mr. Bell tell me just what machinery can be brought in free under this Act?

MR. B. T. A. BELL.—That would be a big contract. The whole essence of the Act lies in the words "class or kind." For instance rock-breakers as a *class* are made in Canada, but the types known as the 'Forster,' 'Wiswell,' 'Cyclone' and numerous other *kinds* of crushers are not manufactured, and we are entitled beyond a peradventure to bring in these free. The same applies to pumps, and all the various *kinds* of specialties not manufactured here. The Department evidently is not posted on the details of the subject.

John E. Hardman, S.B., M.E., Oldham, N. S. Vice-Pres. Mining Soc. of Nova Scotia.

MR. E. B. HAYCOCK.—I have brought in a gold mill and other machinery and have never found any difficulty in getting entry duty free. I asked the Department if I could import a Cameron pump free and received a favorable answer.

CAPT. ADAMS.—I wish to move that it is the opinion of this Association that the Dominion Government should remove all duties upon mining machinery.

MR. JOHN E. HARDMAN, (Halifax), said he had had considerable experience in the operations of the Act, particularly with reference to the importation of machinery for gold mining. At first they had found some difficulty in getting the Collector to arrive at a proper interpretation of the meaning of the Act. As an example copper plates were admitted free of duty, but when silvered for amalgamating purposes the Government, in order to protect a few silver plating works—who as a matter of fact had no bath large enough to take in these plates—charged the duty. Representations were made by the Gold Miner's Association with a result that a clearer understanding now existed in Halifax and there was comparatively little difficulty now in getting free entry for machinery. In every case where the form of declaration had been filled in the importer had never failed to get his machinery in free of duty.

MR. W. H. IRWIN.—Unfortunately our experience at the port of Sherbrooke has been very different.

MR. HARDMAN.—In Nova Scotia we have no fault to find with the Act.

MR. W. H. IRWIN.—While I quite sympathise with Capt. Adams' motion, I do not think any practical results can be obtained by passing it. I would move that a deputation from the association be appointed to confer with the Comptrollor of Customs at Ottawa, with the object of obtaining, if possible, a definition of what machinery can be imported free under the Act.

MR. L. A. KLEIN.—I know of many instances where the duty on mining machinery has been collected in Quebec. I see no practical benefits the Act confers on our province.

MR. R. T. HOPPER.—Mr. Klein corroborates my experience.

Mr. Irwin's motion was then put to the meeting and was carried unanimously.

The following were appointed to wait on Comptroller: Messrs. Hector McRae (Electric Mining Co.), Ottawa; W. A. Allan (Little Rapids Mine), Ottawa; S. P. Franchot (Emerald Mining Co.), Ottawa; E. B. Haycock (Star Gold Mines), Ottawa; R. T. Hopper (Anglo-Canadian Asbestos Co.), Montreal; J. Burley Smith (British Phosphate Co.), Glen Almond and B. T. A. Bell, editor CANADIAN MINING REVIEW, Ottawa.

The License on Powder Magazines.

MR. S. P. FRANCHOT asked what had been the outcome of the representations made by the Association respecting the repeal on the tax on powder magazines at mines.

HON. GEORGE IRNINE, Q.C.—A deputation waited on the Hon. J. S. Hall, Provincial Treasurer, at Quebec. We were received very favorably and he promised to give us a reply later on. He wrote the other day as follows:

QUEEEC, 4th February, 1893.

HON. GEORGE IRVINE,

President Mining Association, Quebec.

DEAR SIR,—When the deputation of the Mining Association met me the other day, I promised an immediate answer. I saw a great deal of justice in the demand of the Association and delayed answering hoping to be able to give some relief this session, but, after carefully considering the matter, I don't see how I can open the question, but in the re-adjustment that will take place for next session, I have no doubt I will be able to accede, in part, to your request. I hope, therefore, you will see that the members of the Association pay what is due.

Yours truly,

JOHN S. HALL.

Amendment to Constitution.

MR. S. P. FRANCHOT—Moved that Section 10 of the Constitution and By-laws entitled "Duties of Officers" be amended by adding the following words:—

"A President shall be elected at the Annual General Meeting by ballot, and shall not be eligible for re-election to a third consecutive term of office."

MR. BELL.—We cannot consider amendments of this nature without notice of motion. Such a course would be irregular and would establish a dangerous precedent.

MR. FRANCHOT.—This is our adjourned annual meeting. We have a full attendance.

HON. GEORGE IRVINE.—I think Mr. Franchot's idea is common sense enough; but I do not think there is any common sense in making alterations to the Constitution without notice.

MR. FRANCHOT.—I think I am within my rights in asking for a vote.

MR. BELL.—At the Annual Meeting on Wednesday I asked if it was the wish to read over the Constitution, with a view to the consideration of any amendments. It was too late now, without notice of motion and a special meeting called for the purpose.

MR. A. W. STEVENSON.—Moved the appointment of a committee to revise the Constitution and By-laws and submit any such to the next Quarterly General Meeting.

MR. BELL.—Seconded.

MR. L. A. KLEIN.—According to Constitution the Association should hold four meetings in the year, but the meetings had been held at the sweet will of the Secretary.

MR. BELL.—The meetings have been called by Council. No fewer thon than eight had been held during the past year. The September meeting had, however, been dropped. There was no use in calling the members together unless they had something to discuss.

Mr. Franchot's proposed amendment was put to the meeting and carried.

MR. W. H. IRWIN—Suggested that all the past presidents of the association should be appointed honorary presidents.

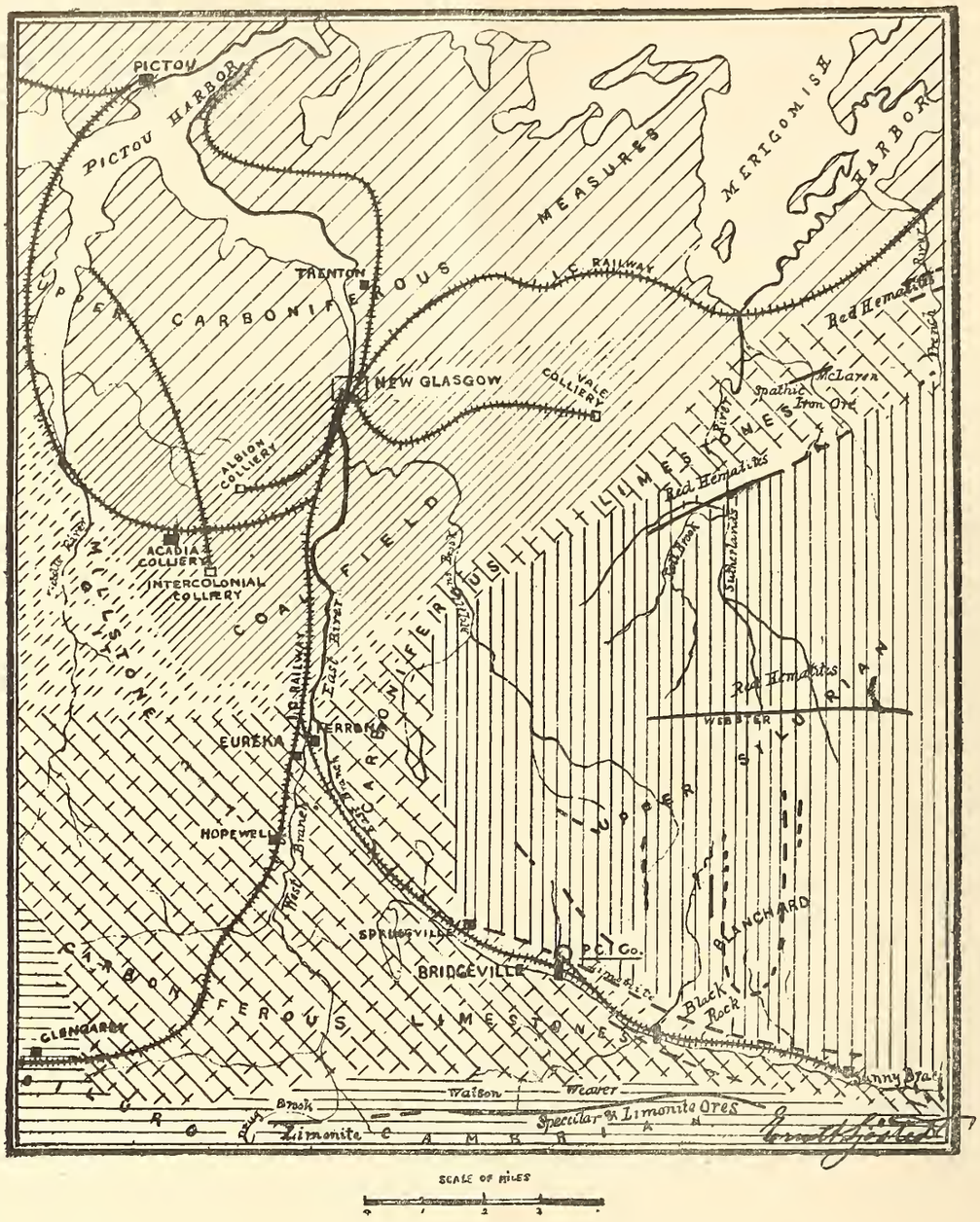
The Secretary's Resignation.

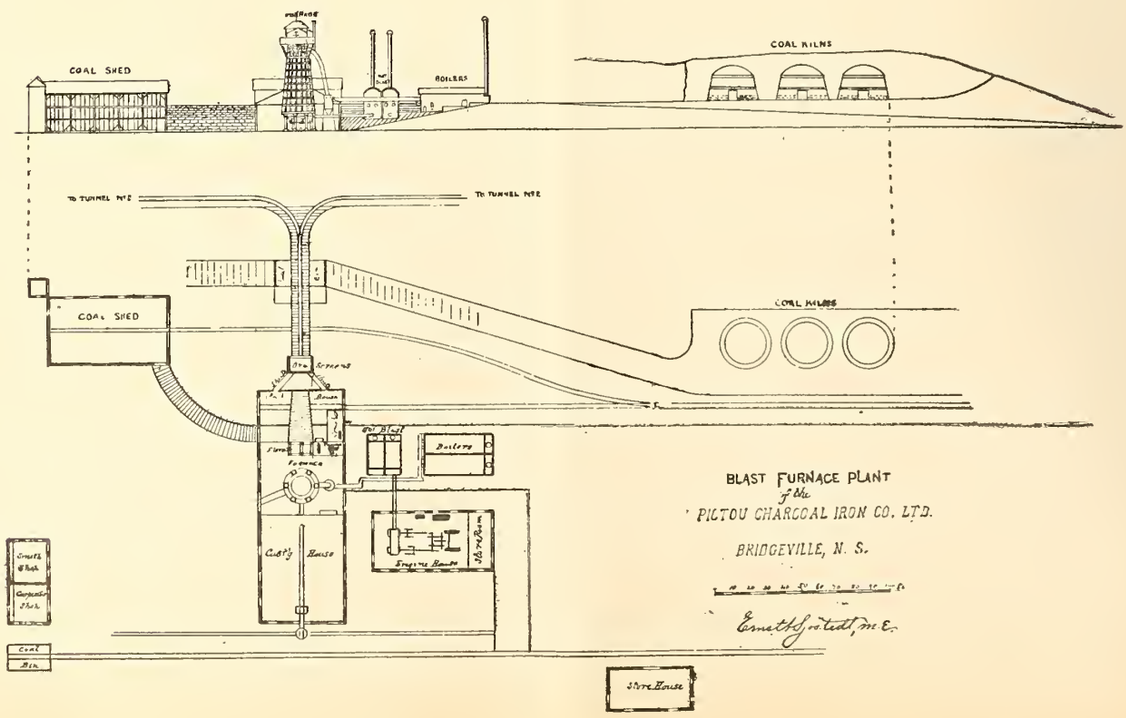
MR. BELL reminded the Association that at the previous meeting he had tendered his resignation and that the office was therefore vacant. He regretted that the increased work incidental to the Association's operations seriously interfered with his business and compelled him to ask for the election of one better able to attend to their interests.

After some discussion Mr. Bell consented to officiate until the next quarterly general meeting on 7th April.

A National Museum Wanted.

MR. BELL—On the list of resolutions unfortunately crowded out of the business at the united convention last evening was one which deserved the attention of this Association. He referred to the urgent necessity for enlarged and safer housing of the magnificent national collection gathered by the staff of the Geological and





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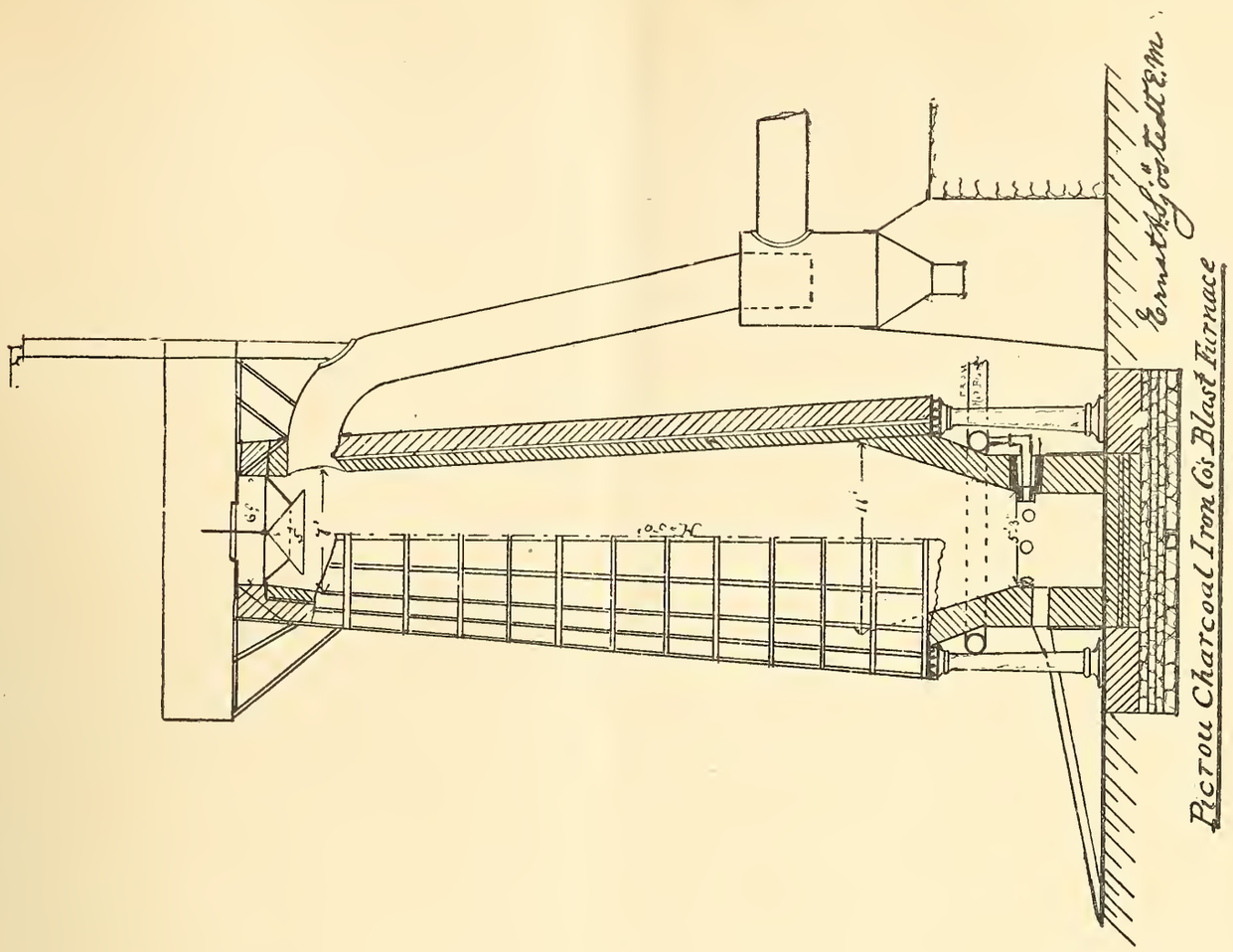
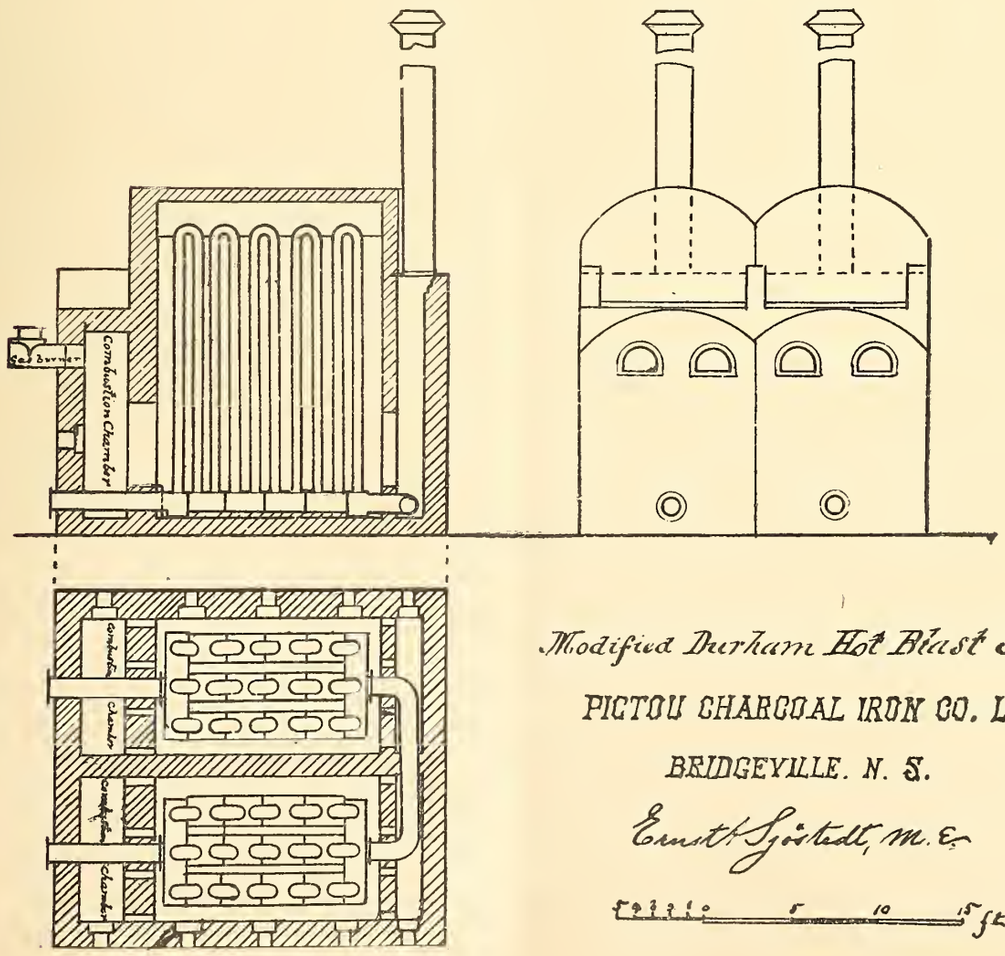
BRIDGEVILLE, N. S.

Ernest J. Corbett, m.E.





Modified Durham Hot Blast Stoves

PICTOU CHARCOAL IRON CO. LTD.

BRIDGEVILLE. N. S.

Ernst Gyöstedt, M. E.

0 5 10 15 ft.

Natural History Survey of Canada. The building was antiquated and wholly inadequate to the wants and uses of such an important branch of the publicservice. Being contiguous to a tenement of stores it was in danger of being destroyed by fire at any moment. Thefloors were shaky and threatened to cave in. A large portion of the collection, for lack of accommodation was crowded into the open yard where valuable specimens lay exposed to the inclemency of the weather. The time was opportune to press upon the Dominion Government the urgent necessities of the case. The building contained the most precious collection of minerals, fossils, botanical and antiquarian specimens contained under one roof in the North American continent. The loss of such a valuable collection would be irreparable. The Governmeat had spent hundreds of thousands of dollars in exhibiting the resources of the Dominion in Great Britain and Europe and extensive preparations were being made for a costly exhibition in Chicago. In Ottawa the Government today could not show properly, even to the members of its House of Commons, the wealth of our country, many of whom are as ignorant of our great national resources as the veriest stranger who comes within our gates. He moved that the deputation appointed to interview the Comptroller of Customs, should, on the same day, seek an interview with the Hon. the Minister of the Interior and urge upon him the necessity of enlarged and safer housing of these great national teasures.

MR. W. A. ALLAN briefly seconded and the resolution carried unanimously.

A Suggestion for Dr. Selwyn.

CAPT. R. C. ADAMS moved that the Association through the secretary, express to the Director of the Geological Survey its desire that the valuable photographs exhibited by Dr. Ells, during the discussion of his paper on the "Apatite Deposits of the Province of Quebec," before the United Convention, be reproduced in colors and issued as part of the Survey Reports.

MR. W. A. ALLAN suggested that the matter might suitably be brought to the notice of the Minister of Interior at the time of the interview anent the survey building.

Votes of Thanks for Courtesies Extended During the Convention.

MR. W. H. IRWIN moved that the hearty thanks of the Association be tendered to the following for courtesies extended to the Association and its guests :

Directors of the Victoria Skating Club.
President of the Montreal Amateur Athletic Association.
President of the St. George's Snowshoe Club.
President of the Thistle Curling Club.
President of the Montreal Snowshoe Club.
Governors of McGill University.
President Canadian Society of Civil Engineers.
Canada Iron Furnace Company, Montreal.
Col. A. A. Stevenson, Montreal.
Sir Donald and Lady Smith, Montreal.
T. G. Shaugnessy, Canadian Pacific Railway, Montreal.
The Dominion and Quebec Governments.
The meeting then adjourned.

Meeting of the Mining Society of Nova Scotia.

The members of the Mining Society of Nova Scotia met in Lecture Room C., Physics Building, Montreal, on Wednesday afternoon, 22nd February. Mr. H. S. Poole, F.G.S., A.R.S.M. (Acadia Coal Co.) in the Chair. The hall was crowded ; a number of members of the other mining organizations being present. The first paper submitted was that by Mr. E. Sjostedt, Bridgeville, N. S., entitled :

Notes on the Ores and the Blast-Furnace Plant of the Pictou Charcoal Iron Co., Ltd., Bridgeville, N. S.

During the last few years much has been said and written about the "wonderful mineral resources" of Ganada, especially of those in Nova Scotia.

Being attracted by these reports, as well as by the liberal inducement extended by the Government (at present consisting of a cash bounty of $2.00 per net ton on iron manufactured in Canada, form Canadian ores, and a duty of $4.00 on imported pig, or a protection of $6.00 per net ton, or $6.72 per gross ton), the writer, in 1890, decided to head a movement for developing these deposits. After much labor and time spent, a "prospecting company" was formed, the object of which was to ascertain where, in the Lower Provinces, there would be a suitable place for locating a charcoal iron industry.

A charcoal iron plant seemed to offer the best inducements for investment as charcoal iron is made in Canada only on a limited scale, and 10,000 to 15,000 tons have been imported annually during the last few years. The greatest part of this importation is used in the manufacture of car wheels, and owing to the very extensive railroad systems now completed and under construction in this vast country, it is evident that the demand for this grade of iron is on the increase, and no doubt will soon assume important proportions.

An extensive prospecting tour was made throughout New Brunswink and Nova Scotia, and as a result of this exploitation the East River of Pictou, Pictou County, Nova Scotia, proved to be the most promising field for the industry in question, and a furnace site was eventually selected at Bridgeville, in the close proximity of the ore and limestone beds.

A glance at the accompanying sketch map of the iron and coal fields in Pictou County (see Mines Inspector Gilpin's paper in the Transactions of the Am. Institute of Mining Engineers, Vol. xiv.), is sufficient to show the favorable position this place holds. Situated on the line of junction of the upper silurian strata and the lower carboniferous limestones, where extensive deposits of limonites and large beds of pure limestones are found, it possesscs the advantage of short haulage of ore and fluxes to the furnace ; and as nearly all of the Silurian and Cambro-silurian districts here are well wooded, there are large tracts of old-growth hardwood available for charcoal making in the immediate vicinity, besides thousands of acres along the I. C. R. and the projected railway line of the Nova Scotia Midland, all inside of a radius of 25 miles.

The newly built railroad from Eureka Junction (on the I. C. R.) out to Sunny Bae, together with the above mentioned projected line out to the Atlantic coast, besides, not only furnish ample transportation facilities for the furnace material, but will give an outlet for the manufactured iron to the Intercolonial system of railways and to deep water harbors at Pictou and on the Atlantic,

Here mining rights for ore and lime rock were secured, a furnace site purchased and extensive tracts of hardwood land bought. These rights and properties were transferred to the Pictou Charcoal Iron Company, Ltd., at its organization in November 1891. The foundation of the works was laid before the winter set in, and plans and

Charles Archibald, M.E., Cow Bay, C. B., Manager, Gowrie Coal Co.

calculations were made for completing the plant by the following July. The unexpected difficulty met with in securing sufficient funds for the enterprise, however, necessarily retarded the progress of the work, and the year had nearly come to a close before the furnace could be put in blast. The annexed sketch gives plant and elevation of the works at Bridgeville in their present completed state.

The buildings consist of a convenient office, stables and store houses, a carpenter and blacksmith shop, a coal shed (with a capacity of 40,000 bushels), a carting house, stock house, and engine house. The shops and furnace buildings are all covered, roof and sides with corrugated iron, painted on both sides with mineral paint.

The working plant proper consists of the following structures :

The Furnace Stack (see accompanying sketch) which is 50 ft. high, with 11 ft. bosh and 7 ft. diameter under the bell. The conventional iron shell has here been dispensed with and substituted by a crinoline strapping and red brick shell. This, together with the 15 in. fire brick lining is supported by six cast iron columns, and the bosh is surrounded by a boiler-plate mantel, and the hearth by a water cooling cast iron jacket. The tuyers, six in number, are of bronze, and set in water coil breasts. The down-comer has a diameter of 36 in., and the bustle pipe 15 in. The top of the furnace is provided with a Weimer patent friction winch and gas seal for facilitating an even distribution of the stock, and to prevent waste of gas.

The hot-blast is a modified Cooper-Durham cast iron stove, with 30 U-pipes, and built in two sections and provided with two combustion chambers side by side, and so arranged that the cold blast inlet and the outlet of the heated blast, as well as the two combustion chambers, are placed in the same end of the stove (as seen from annexed sketch). This arrangement was successfully adopted by the writer some years ago at Katahdin Iron Works, Maine. Besides economizing space and blast and gas connections it facilitates maintaining the blast at a high temperature with a small amount of fuel-gas, the 2,000 ft. of heating surface sufficing to keep the 3,000 cub. ft. of air per minute (engine measure) up to 750° to 800° F.

The boilers are four in number (20 ft. x 36 ft.), made of best $\frac{5}{16}$ in. Dalzel steel, and built in sets of two, with separate draft stacks, and independent steam and water connections, and provided with gas valves and combustion chambers similar to those in the hot blast, besides separate grates for wood or coal, in case of shortage of gas.

The Blowing Engine consists of two horizontal blowing cylinders of 5 ft. diameter and 5 ft. stroke and a pair of horizontal steam engines, 18 in. x 36 in., each one capable of performing the work in case of necessity.

The Elevator comprises a double Whitney hoisting machine and two Wood & Co's safety cages. These, as well as the limestone breaker (a Forster "crusher and pulverizer ") are run by belt from a horizontal steam engine of about 15 h. p. capacity. And for the handling and weighing of the stock and the pig iron the Weimer patent steel charging barrows and Riehle's furnace charging and pig metal scales are used.

Water supply has been provided for by building a 25 ft. high dam on Mill Brook from which the water is conducted 700 ft. through 3 in. wooden pipes to the furnace, besides which a reservoir is built (at an elevation of 75 ft. above the foundation level of the furnace) for collecting the spring water from the hills above, as well as the water pumped from the river. In case of lack of water from the above mentioned sources, a Northey duplex steam pump (7½ in. s. c. x 4 ½ in. w. c. x 10 in. st.) is performing this work, and a series of iron pipes are laid to the reservoir and to different parts of the works, and fitted with valves, hydrants and hose connections for fire purposes as well.

For the carbonization of the wood 19 brick kilns have been erected at different places. These are of the round (bee-hive) type, and each one holds 50 cords of wood, and is capable of carbonizing 1200 cords per annum, which will produce 50,000 bushels of coal. Those built in the woods are of the Plattsburg (conical type), each holding about 30 cords, and has an annual capacity of 700 cords of wood, or 30,000 bushels of coal. The present coaling capacity is, therefore, about 500,000 bushels per annum, requiring about 13,000 cords of wood. Three more kilns will be built in the spring, making the total capacity about 600,000 bushels of charcoal, which is the estimated requirement for producing 5,000 tons of pig iron a year. The wood used for the charcoal making is principally yellow birch, also beach and maple.

The iron ores on the north side of the East River of Pictou have been opened up in several places between Springville and Sunny Brae, and are at present worked by us, in two places on the Wm. Grant farm at Bridgeville, and by the N. G. I. C. & Ry. Co., both at Bridgeville and at Black Rock. They are contact deposits between the carboniferous limestones and the upper silurian measures, and consist of brown hematites, "residual precipitates formed from the disintegration of the older silurian rocks above," more or less mixed with pyrolusite, in form of nodules and masses, mostly in the hanging wall, but also as veins or crystals in the deposits themselves. On the south side of the river there are the Weaver and Watson specular ores, but these have as yet not been worked.

Our ore deposits being but a few hundred feet from the furnace, on a hillside on an elevation of about 100 ft. above the same, the mining and hauling of the ore is rendered especially easy. Two tunnels have here been driven, one on the east and one on the west side back of the furnace. The latter, or our "A tunnel" goes through a seam or vein of gravel ore, easily mined, and 10 to 15 feet in width. After having carried it in about 300 feet a slope was driven up through the ore, at an incline of about 45° S.W., to the surface 60 ft. above, which showed up a large body of ore, in some places 18 ft. wide. The ore in our "No. 2 tunnel" is of an entirely different character, being fibrous and compact, and requiring blasting. It is besides, richer in metallic iron, nearly free from manganese. This ore was first worked by an open cut on the top of the hill, as it displayed a remarkable deposit of solid limonite, yielding 58 per cent. metallic iron ; and 3 to 4 thousand tons were removed. About 60 feet below this cut we have now driven one tunnel about 200 feet in the same kind of ore, besides an air shaft (at an incline with the dip of the ore of about 60 deg. south) ; and three different levels, all in ore from 10 to 15 feet wide.

The following analyses will serve to give an intelligent idea of the above mentioned ores :

	Gravel ore from No. 1 Tunnel.		Compact ore from No. 2 Tunnel.	
Insoluble matter.....	12·80	6·75	8·58	5·58
Metallic Iron	45·02	53·41	54·83	56·57
Metallic Manganese.....	1·56	1·88	0·20	0·20
Comb. Water.....	9·45	11·02	10·00	10·90
Sulphur.....	0·05	0·04	0·41	0·09
Phosphorous.....	0·12	0·02	0·03	0·21

The variation in manganese and sulphur is, however, even more marked than the above figures indicate, as crystals of Pyrolusite and Barite are met with here and

there among the ore, without any regularity or warning. Our intention is to wash and roast our ore before using it in the furnace; but at present it is simply heap-roasted, with wood and charcoal braize, at the end of the tunnel track. From here it is afterwards carried on the tramway tracks (indicated on the plate II.) to the hute above the stock-house; and being here dumped on iron rails, placed about two inches apart, and broken sufficiently to pass through these, it falls on a wire netting (No. 10 gauge 3x3 mesh) down in the stock-house, whereby the dry clay to a large extent is screened through and separated from the ore.

The limestone used for flux is quarried at Springville, and from there hauled (3 miles) to our furnace, costing us about 85 cts. per gross ton delivered. It contains about 94·0% carbonate of lime; 2·5% carbonate of manganese; 2·0% insoluble matter.

Other valuable limestone deposits are found in several places near Bridgeville and at Black Rock and Sunny Brae, but of these only the one at Black Rock is opened up and worked—and this by the New Glasgow Iron Coal and Railway Co. The composition of this lime is reported to be as follows:—

Carbonate of Lime	94·30
Carbonate of Manganese	1·71
Oxide of Iron	·20
Oxide of Alumina	1·36
Silica	2·05
Phosphorous	·008
Undetermined loss	·372
	100·000

MR. GRAHAM FRASER (New Glasgow Coal, Iron and Railway Co.)—I have had great pleasure in listening to Mr. Sjostedt's paper. He goes very clearly into the matter, and gives a lucid description of the ore deposits of the East River of Pictou. I have no doubt that his company has a great future ahead of it. There is plenty of wood to make charcoal; and if that fails, we have the coal districts as a corps de reserve, to say nothing of coke iron. I must thank Mr. Sjostedt for the pleasure I have had in hearing his interesting paper.

MR. SMAILL (Londonderry Iron Co).—I know the ores used by the Pictou company. Their average last year was about 52 to 56 per cent. of the metallic iron, and was very rarely below 52: generally over 55, just as it comes from the mines. There is one thing about the gravel ores of that district—they take imitative shapesin their deposits.

I think, Mr. President, that Mr. Sjostedt and Mr. Fraser might add a great deal to the Society's collection of iron ores; and I think the Society ought to ask them if they would not add their specimens to the collection.

Do I understand Mr. Sjostedt to say that in all cases the ore he mines is a contact deposit, and that it is taking the place of limestone, washed away by percolating waters.

MR. SJOSTEDT.—It is so considered by most geologists. Our works have been carried on only a short time. The ores are decidedly richer than any similar ores found in Alabama, and arc of great promise so far as we have gone. They are more regular than most similar ore in Alabama. In regard to Mr. Smail's suggestions, to send samples, I may say we have exceptional facilities for getting samples, and we will be glad to send the Society some at an early date.

Hon. W. S. Fielding, Halifax, Premier of the Province of Nova Scotia.

Electrical Coal Mining.

MR. JAMES T. BURCHELL (Gardener Coal Company), said: From the rapid increase in the number of coal mining machines used, the increasing quantity of coal produced by machinery, and the fact that in many collieries where machine mining has been tried the number of machines is being increased, I think that we can take the ground that the practicability of cutting coal by machinery is an established fact.

Any one that is at all familiar with the reclaiming of coal by this means will readily concede that it has many advantages over coal cutting by manual labor. First among these, and most important, is economy of production. Second, saving of coal or rather greater proportion of large coal and less slack or culm. Third, less powder required to blow down the coal, as the undercut is so much deeper. All mining men will readily understand the advantage this is to the coal. Fourth, less pit-room required for same output, consequently less number of tracks to be laid. Fifth, much less danger to workmen, as a large percentage of accidents occur to miners while undercutting. The fact then established that the coal mining of the future has to be done by machinery if we are to compete successfully in the production of coal, it is important to consider the machine that is most suitable for the work required and the most economical way to transmit power to drive it.

In considering the first point, I would say that many different kinds of coal cutting machines are now being successfully used, all of which have their advocates, but the types of machines that so far have done the most successful work are those of the reciprocating pattern such as the Vouch, Harrison, Ingersoll-Sergeant and the Sperry, and the Rotary or revolving pattern as represented by Jeffrey, Leichner, Thompson, Van Depoele, Schlesinger and Edison. Those of the first named pattern attack the coal by a blow as with the pick, and as they are under the complete control of the operator can be guided so as to perform the work in coal and avoid contract with iron or sulphur balls that it would be impossible for the Rotary machine to work through. They have the advantage of being much lighter, some of them weighing only about 500 lbs, consequently are easier to move from room to room, and the cost of the machine is less than those of the other pattern.

The working of these machines is harder on the operator and requires more skill in handling than those of the Rotary pattern. The Rotary or revolving machine will do better work and more of it, with less labor for the operator, when the circumstances are favorable for its successful working. Where the seam is thin it requires an even floor, must have the coal clear of impurities of a hard nature and requires a good roof, in fact all mining machines require this, as timbering close up to the face of the work would be very much in the way of the machine. The Rotary machine being of greater length than the others requires a stronger roof, the lighter machine having a better chance to work around the timbers.

Neither of these types of machines can be expected to give satisfactory results in all mines or all classes of coal, and if this fact were better understood there would be less prejudice against coal-cutting machines, a more intelligent investigation into the question of adaptability of the machine to do the work required, and I am confident it would lead to a much more rapid increase in the use of coal-cutting machinery.

In Cape Breton the Ingersoll-Sergeant is worked successfully in the Emery colliery of the Sydney & Louisburg Coal and Railway Co., in the Gowrie mine of Messrs. Archibald & Co., and at the Caledonia colliery, where I am told the plant is to be increased.

The machine that I am most familiar with is the Jeffrey Electric Coal-Cutting machine. This machine consists of a bed frame 2 feet wide, by 8½ feet long composed of two steel channel bars firmly braced, the top plate on each forming racks with teeth downwards into which the feed wheels of the sliding frame engage. Mounted upon this is the sliding frame upon which is placed the electric motor from which power is transmitted through straight gear and worm wheel to the rack by means of which the sliding frame is fed forward. Upon the front end of the sliding frame the cutter bar is placed. The cutter bar contains steel bits, held in place by set screws—this bar is driven by an endless chain. The machine is operated by two men—it is run up to the face of the work on a truck, unloaded and firmly jacked against the face of the coal, and the roof in rear of the machine. The power is then turned on by the man in charge of the machine and it proceeds to work, the cutter bar being revolved by the endless chain is fed forward to a distance of five feet, making a cut of that depth, three feet three inches wide and four inches high. When the cut is completed the lever is reversed and the cutter bar withdrawn. The jacks are slackened down and the machine is moved broadside across the width of the cut placing it in position for the next cut. After the room is then cut entirely across, the machine is loaded on the truck and removed to the next room.

When we come to consider the second point, the most economical power to use, I know I am treading on dangerous ground. The question of electricity versus compressed air, has been a battle ground for the past few years. One of the strongest papers that I have noticed in favor of compressed air as against electricity is by David J. Lloyd, manager of the Edinburg Coal Co., published in the *Colliery Engineer* of December last, in which he shows a loss of 68 per cent. of power from the generator to the motor, or only an efficiency of 32 per cent. of the power conducted by electricity, also a loss of 40 per cent. from the engine as developed by the generator, making in all a loss of 81 per cent., or only 19 per cent. efficiency of power of engine produced at motor. While his compressed air plant shows a loss of only 34 per cent. from steam to air, and a loss of 7·4 per cent. from the compressor to the mining machine. I do not think that this is a fair comparison, as Mr. Lloyd admits that the electric mining machine that he tried was a failure and never made a single complete cut. Mr. Lloyd figures the loss of 68 per cent. from generator to the cutting machine, because his generator was developing 23.5 h.p. and his motor on machine was rated only 7½ h.p. He admits that there was no loss on the wires, so that the full current of 23.5 h.p. was delivered at the machine. Now it is quite clear that if the current was delivered at the machine his motor, although only rated at 7½ h.p., must for the short time it worked have developed 23.5 h.p., less loss of the efficiency of the machine, but as Mr. Lloyd does not take this loss into account in estimating the power of his air machine, it need not be considered, so that we can at once strike off the 68 per cent. loss. The loss he shows from the generator and engine, 40 per cent., although only 6 per cent. higher than he shows from the engine and compressor, is at least 10 per cent. greater than is usually found in well designed steam and electric plants of similar size, this I think can be accounted for in his case by the use of an engine at least double the size he required to do his work, which would double the percentage of frictional loss of the engine, as steam engines are usually found to show about the same loss of friction irrespective of load.

Applying to one of the largest manufacturers of compressed air and electric mining plant in the United States for a comparison, I secured the following reply. "We consider electric power the strongest, steadiest, mosteconomical and the simplest to handle. The loss in transmission of power from power house to mine is less with electricity than with the air. The liability of leaks in pipes, also friction is greater with air, so much so that in mines where we have the air power in use, we have a loss some days as high as from fifty to sixty per cent., while at other mines, the same distance with electricity, the loss is less than thirty per cent."

In my own experience I have not found nearly as much loss, I have tested the current day after day when the machine, with motor, was 800 feet from generator, and found the loss not to exceed five per cent. This loss can be almost completely overcome by increasing the size of the conductor so that resistance will be lessened in the transmission, and by proper insulation. Many of the mines in the United States are wired with bare wire without any insulation.

I append hereto a tabulated statement prepared by the Chief Inspector of Mines of the State of Ohio, who, accompanied by three expert electricians, visited eleven collieries where electric machines were in use, opened the circuit at each machine and inserted an ampere and volt meter and recorded the reading every fifteen seconds throughout the cut. This statement shows the h. p. required to overcome the frictional load to be between five and six, and that only six h. p. is required to cut a square foot of coal in a minute in some cases, and in others fourteen h. p. is required. This great difference is due to the fact that the coal is much harder in some mines than others and also to the cutting bits becoming dull, the test being made under all these different circumstances.

I have often seen a cut made with sharp bits in four minutes, when in the same coal if the bits were allowed to get dull it would take ten minutes. An excellent paper on this subject by Mr. D. S. Bigge was read before the North of England Institute of Mining and Mechanical Engineers at Newcastle on February 13th, 1892, an ab-

stract of which appeared in the *Colliery Engineer* of April last, in which he speaks strongly in favor of electrical power. This paper, I would advise, every one interested in this subject to read.

The phenomenal advancement of the introduction of electricity as a motive power should lead any one intending to install a mining plant to carefully consider its many advantages, and although its advocates have met with many discouragements it continues to make rapid advancement, and I have no doubt that at no distant day it will become the leading form for the transmission of power.

Among some of the advantages claimed for electricity is that the power can be carried longer distances with less loss than by any other means, and at less cost. The conductors requiring less space can more readily be put in position by less experienced workmen and connections for branch circuits more easily made than on conductors of any other power.

Electric power can be utilized for more kinds of work. I might mention coal cutting, hauling either by motors or electric hoists, pumping, running fans and lighting.

Having undertaken to run a thinner seam of coal than had previously been successfully worked in Cape Breton where so many large seams of coal exist, I found I was compelled to pay a higher rate for coal cutting than was paid at any of the other collieries. I commenced two years ago to enquire into the practicability of mining by machinery, and after careful examination of most of the machines worked in the United States, I purchased a Jeffrey Coal Cutting Machine worked by electricity, and had Messrs. Robb & Co., of Amherst, install an electric plant. The generator was 30 h. p. placed about eighty feet from the mouth of the shaft. We used No. O Okanite wire to conduct down the shaft and the ordinary insulated wire from foot of shaft to where the machine worked, a distance of seven hundred feet. The motor attached to the machine was rated twelve to fifteen h. p. I felt at the time that I was running quite a risk in attempting to run electric power, situated as we are, hundreds of miles from any one who knows the first thing about electricity; but the machine was put to work in September, 1891, and has worked constantly since, with the exception of the time the mine was idle in winter months. The machine never missed one day's work when we had work for it to do. Any repairs that it required were done on the ground and always in time for the machine to do its day's work. It takes from four to six minutes to make a cut five feet deep and three feet three inches wide. We have cut a room twenty-five feet wide across in fifty-five minutes. It takes thirty minutes to move the machine from one room to another. But we have had the best results when we have used the machine in Long-wall workings, where it has cut a face of one hundred and fifty-five feet by five feet deep in eight hours. When we have worked the machine on a face of Long-wall we have saved 30 per cent. in cost of cutting.

I make no claim for the superiority of this machine, but merely give my own experience. Other machines that I have not had any experience with may do as well or better. Several have been patented within the last year that give promise of doing efficient work. A description of one called the "Brown Coal Cutting Machine" invented by Adam Keil, of McKeesport, Pa., appeared in the July issue of the *Western Electrician* and has many excellent points.

While leaving the choice of machine an open question, I do not think there can be a doubt in the mind of any one who has had any experience with electricity, that it is far ahead of any other power when the work is at a distance from the power house.

There may be some types of machines working successfully with compressed air, to which as yet electrical power has not been applied, but this does not disprove my contention.

I have found in the use of electricity that the most important objections raised against it are imaginary. There is no danger to workmen from contact with wires, as it would require a current at least three times as strong as is generally used for mining purposes to cause the slightest danger from contact with even the bare wire, and there cannot possibly be any more danger of exploding gas by the flash from the brushes than there is from a naked lamp, therefore this agument cannot be raised against its introduction in Cape Breton where naked lamps are used in all our mines, still it must be admitted that in very gassy mines electricity as at present used would be attended with some danger. But the objection that is most often made use of is perhaps the most absurd one, that it is a new power that we cannot understand. If we refuse to make use of any power that we do not understand, I am afraid some of us would not do very much mining. I am not an electrician and must confess that I know very little about electricity, except that its power can be carried safely and economically from the surface to the most remote parts of a mine and there made to do efficient work.

THE CHAIRMAN—Mr. Burchell has read us a very interesting paper, and has thrown down several gauntlets which I hope will be taken up.

MR. R. H. BROWN (Sydney Mines).—How many workmen's labor does that 30 horse power that is developed save?

MR. BURCHELL.—It saves the work of eight colliers, and some days as high as sixteen. Although our generator is 30 h. p. we rarely make use of more than 15 h. p.

MR. HARDMAN (Oldham Gold Co.)—Whatever I may have to say, I do not wish my remarks to be construed as being the outcome of an advocacy of compressed air rather than electricity. I am not an advocate on either side, but take the point in criticism, that nothing has been said in Mr. Burchell's paper which would lead any one to believe that he has made any standard measurements. In other words, has Mr. Burchell indicated his engine so that he knows how much horse power is consumed so as to drive this 7½ h.p.? Compressed air must be understood distinctly as having a field of its own; and that in the dynamo work there is a limitation for each form of transmission. The transmission by wire rope has its own particular field. The transmission by compressed air has another field entirely its own, and the especial long distance transmissions are undoubtedly the field of electricity. I should like Mr. Burchell to state definitely what the power is that is delivered to his generator, and if he is prepared to say that the 7½ h.p. motor is not in reality a larger motor and does it not absorb more than the 23½ h.p., rather than indicated by the statement that it is simply a 7½ h.p. motor? My experience has been that the electrical companies could not or would not guarantee a definite percentage of power recovered from the initial power given.

MR. MEDBURY (Thomson-Van Depoele Electric Co.)—In reply to Mr. Hardman, and as an electrical man of electrical experience, I may say that my company, and I think all companies, will guarantee that the motor will show an efficiency of 70 per cent. of the power developed by the engine.

MR. BURCHELL—In reply to Mr. Hardman, I may say that our engine is larger than is required for the work, having made use of one we had on hand previous to purchasing our electric plant; it is capable of developing about 40 h.p., and when in its full capacity our generator indicates 80 amperes, 200 volts, equal to 30 h.p. We do not use this amount of current, as the work is generally performed with 50 amperes and 220 volts, between 14 and 15 h.p. Occasionally, when the machine gets into a very hard pan of coal, it runs up as high as 20 h.p., but when our motor is run at 14 h.p. the engine is only developing a corresponding h.p. Mr. Hardman, I think, has misunderstood part of my paper. The 7½ h.p. motor he referred to was one Mr. Lloyd had used.

L. A. Klein, M.E., Resident Engineer, Am. Asbestos Co., Black Lake, Q.

MR. J. BURLEY SMITH, (British Phosphate Co.)—To me it seems unfair to make any comparison between the loss in transmission of compressed air and electrical energy, unless the conditions under which both are tried are equal. For instance, it would be naturally unfair to say there was a loss of a certain percentage of compressed air in the transmission of a certain number of miles, unless it was quite certain that all the joints of the pipes were perfectly tight and there was no leakage in the distance.

MR. CHAS. ARCHIBALD, (Gowrie Coal Co.)—I think Mr. Burchell deserves great praise for being the first to use electricity for the purpose of coal cutting in Cape Breton. Yet I say, that so far, compressed air has the advantage, inasmuch as there has been no machine yet perfected to equal the Ingersoll-Sergeant coal mining machine. This machine has the advantage of being light, easily moved, and allowing the worker to handle it just like a pick, and avoid obstacles in undermining; and it can also shear coal, as well as under-cut it. On the other hand, the electrical is one that goes right straight ahead, and as there are many obstacles to be met with in undercutting coal, this machine would not be able to under-cut them with the same facility as the Ingersoll machine.

There is another advantage in air in my opinion; and that is, that it is more easily handled and safer for pumps and machines; and although I am not prepared to decide which is the best method, as far as I can see at the present time the compressed air, with the present machine, has the advantage. And while I believe a machine may yet be perfected that will probably put electricity ahead of compressed air, at the present time from my experience I am in favor of compressed air as a motor for using machinery in mines.

MR. SPRAGUE—In reply to Mr. Archibald's statement that compressed air is preferable to electricity, inasmuch as the Ingersoll machine is worked by compressed air, and that no machine has yet been perfected to work by electricity; I would say that an electrical machine worked on exactly the same principle and on the same pattern as the Ingersoll-Sergeant or the Harrison single blow pick machine, has been perfected and is giving excellent satisfaction. It has the advantage that it can be used as a shearing machine, if so required, by a change in its mounting. I would like to emphasize the statement of Mr. Burchell in regard to the fallacy of Mr. Hardman's argument against electricity as compared with air transmission. The statement he made that a 7½ h.p. motor consumed 23 h.p. from the generator was really a point in favor of the motor; which although rated at 7½ h.p. must have shown over 20 h.p. in actual work. In answer to Mr. Archibald's questions as to the danger of damaging an electrical coal-cutter because of the inability of the operator to tell when he was coming in contact with hard obstacles, it is only necessary to say that almost all electrical coal-cutting machines are provided with some sort of automatic cut-out or friction feed, which slips when an obstacle too hard to be cut by the machine is met with, allowing the bar to revolve without feeding forward. Another electrical machine, designed expressly for long wall working, is one carrying a cutting-arm which extends under the coal, making a four, five or six foot under-cut, as the thickness of the seam may require; the machine itself moving straight along the face; thus doing away with the lost time in withdrawing the breast machines, so called, and moving them broad-side along the face for the next cut. This machine in actual practice has cut at the rate of 60 feet a face per hour, making a four-foot undercut, at the Mead Run mine of the North Western Mining and Exchange Company, of Harrold, Penn.

MR. BURCHELL.—In reply to Mr. Archibald, I would refer to the statement in my paper that in some cases machines of the Ingersoll-Sargeant type could be used where the revolving pattern could not; but that the revolving pattern will do more and better work in any seam that it is adapted to. As to the danger of meeting hard substances in under-cutting, I would state that our electrical plant is fitted with an automatic cut-out that breaks the circuit when the machine meets any obstacle too hard for it to cut, immediately relieving the machine of the load and risk of breakage.

Before leaving home I wired the Jeffrey people asking them how many cutting machines they had in use worked by air and by electricity, and the nature of those installed in the mine of late, and they replied that they had 98 electrical and 60 air machines; and that within the past three years all new plants installed were electrical, and any air machines put in, in that time, were merely extensions of the old plants.

In reply to a further question of the chairman, Mr. Burchell stated that the machine was worked along the face of the coal at right angles to the levels.

The Dominion Government Grant to Scientific Societies.

MR. B. T. A. BELL (Ottawa).—I made a suggestion at a meeting in Halifax that the Society should apply to the Government for the grant usually given to scientific societies. I do not know whether anything has been done in this direction?

MR. W. HAMILTON MERRITT (Toronto).—I might say in this connection that when agricultural societies and many other societies get Government grants the mining institutions of Canada should receive greater consideration than in the past in that direction. All mining men are not rolling in wealth, and mining societies if they had a Government grant could do a great deal of good. Now, if each province of our Dominion thought proper, it might organize a society such as our Nova Scotia and Quebec Societies, and in some way or other they could conjointly send delegates, or each society send a member, all to act as a committee in matters requiring Government assistance or legislation.

THE CHAIRMAN.—You would not be afraid that if we applied and got such grants it would be calculated to close our mouths to the uttering of any independent criticisms of the legislation of the Government?

MR. BELL.—We would simply ask the Government to give us a grant to aid in publishing and distributing literature on the mining practice and mineral resources of the country. By publication of papers and discussions in our volumes of Transactions we are promoting knowledge and bringing the mineral wealth of the country into prominence.

THE CHAIRMAN suggested that Mr. Bell might make his suggestion before the United Convention of the Societies on the following day.

The meeting adjourned at 5 p.m.

Combined Meeting of Canadian and American Mining Men.

On Thursday afternoon, 23rd instant, a combined meeting for the discussion of papers by the Canadian delegates opened in the Lecture Hall "A," Physics building. There was a large attendance, delegates being present from the American Institute of Mining Engineers, the Mining Society of Nova Scotia, the Asbestos Club, the Provincial Mining Association of Ontario and the General Mining Association of the Province of Quebec. Capt. Robt. C. Adams, Montreal, Vice-President of the General Mining Association of the Province of Quebec, presided. The proceedings opened at two p.m.

CAPT. ADAMS.—I need not say that it is very gratifying to see such a large and representative attendance at this our first united meeting. We have been penned up in our respective divisions, each endeavoring to do good work; but now, united in an international and continental gathering of mining men, we are to have a number of papers and subjects submitted for discussion. I trust that when we tackle some of the hoary abuses that will be brought to our notice, we shall really see the fur fly.

The Mining Laws of Ontario.

MR. A. BLUE (Director of Mines) Toronto. For three-quarters of a century Ontario was known as Upper Canada. For two-thirds of that period it had a Legislature and Executive of its own, and for the rest of the time it was united with Lower Canada, now Quebec. The union of the two provinces ended with June, 1867, and on the first day of July Upper Canada became a member of the new Confederation with the name which it now bears. Three years before this date the first statute regarding mines and mining was enacted by the Legislature of the United Provinces, having for its title "The Gold Mining Act." This and the Amendment Act of 1865, were the only statutes which dealt with mines and mining down to the date of Confederation; all other control was exercised under the authority of Orders-in-Council and by reservations in the patent from the Crown. Under the latter provision gold, silver, copper, tin, lead, iron and coal were so reserved down to the end of 1823, and gold and silver until the 13th of July, 1866, when a Regulation was approved by the Governor-General-in-Council directing that in all letters patent for lands the clause reserving mines of gold and silver be omitted.

The necessity for exercise of Government control over mineral lands and mines arose in 1845, the first year of exploration and discovery on the north shore of Lake Superior. At first each case requiring executive action was dealt with by Order in-Council as it came up, but in the course of time certain principles were evolved to which general application was given under the form of Regulations. These, however, were changed six successive times within the space of one year, and after a seventh modification in January of 1847, they stood unaltered for nearly seven years. For license to occupy a location and open mines thereon priority of discovery by exploration was a first requirement; but no license could issue until the explorer reported the result of his discoveries to the Government. It was also necessary that a scientific agent of the Government should have an opportunity to mark the boundaries of limits, determine the direction of boundary lines in the case of different courses of veins on adjoining locations, and examine the statements of exploration furnished by an applicant. Reports pointing out and selecting a location were classed according to receipt and held to be the best evidence of discovery; possession by the building and occupying of a hut was proof of the next value; while priority by application was assigned a third rank of value. The extent of a mining tract was first fixed at one mile in front by five miles in depth; but afterwards, in response to the petitions of explorers, the limit was extended to two miles in front by five in depth, the length to be with the course of the mineral vein. The land was sold in fee simple at eighty cents (4s.) per acre, $600 payable at the time of purchase, or when the certificate of location was issued, to cover the cost of surveying and other contingent expenses, and the balance in five yearly payments with interest. Upon these terms the lands on Lakes Huron and Superior were declared open for sale at the minimum price of four shillings per acre, in blocks of ten miles square; and although it was provided that all grants should be subject to such regulations to ensure the working of the mines as Parliament might thereafter enact, it does not appear that any conditions were required or imposed by that body.*

After a trial of seven years the Government became convinced that these Regulations were too burdensome upon the miners. The system of allotting mining tracts had not realized the anticipations formed of it; neither had it enabled individuals desirous of engaging in mining pursuits to effect their objects without compelling them to purchase locations of so extensive an area as to call for a needlessly large outlay on acquiring a right to explore and mine where the signs were favorable. Accordingly, in September, 1853, a new set of Regulations was introduced by Order-in-Council, applicable to Upper Canada only, under which the Commissioner of Crown Lands was empowered to issue to any person upon payment of $100 (£25) a license to explore unceded lands in any county or section of the province (named or described in the license), for copper, lead, iron, tin, marble, gypsum, earths or minerals. The license was to remain in force two years, and the holder of it might take possession of a tract not exceeding 400 acres of unoccupied land, 40 chains front by 100 in depth, and "report his discovery and selection accurately by letter and map within six months from the issue of the license, accompanied by an affidavit made by himself and some other credible person proving that no counter occupation or workings exist." At the expiration of the term of two years the licensee-holder was required to complete a purchase of the tract selected by him at the rate of $1.50 (7s. 6d.) per acre in one sum, or forfeit his right. It will be observed that these Regulations did not apply to gold and silver, unless they could be included under the general designation of minerals. In the next Regulations, adopted by Order-in-Council in March, 1861, gold and silver were specifically excluded, as doubtless it had been intended all along that they should come under the Regulations of 1845-7. The new regulations also abolished the fee of $100 for permission to explore, and provided that locations be sold to the first applicant agreeing to the following conditions, viz.: "That for mining purposes tracts comprising not more than 400 acres each be granted to parties applying for the same at the rate of $1 per acre, to be paid in full on the sale," the applicant furnishing a plan and description of the locality to the Department of Crown Lands, "and on condition that such mineral location be worked within one year from the date of said grant." It was further provided that a patent should not issue until two years from the date of the purchase, and then only upon proof that the purchaser or his assignee had continued to work the location *bona fide* for at least one year previously.

In April of the following year working conditions were abandoned as to future sales, and it was agreed that patents should issue on the payment of the purchase money, but subject to a royalty of 2½ per cent. on ores raised or mined, payable on their value as prepared for market at the mine.

In March of 1864, the royalty of 2½ per cent. was changed to a tax or duty of $1 per ton on all ores except gold and silver, payable on removal from the mine, and this condition was made to apply to all mining lands sold under the Regulations of 1862. It was also provided by the amended Regulations of 1864 that not more than one tract of 400 acres should be sold to one person.

The new tax or duty remained in force only one year, a Regulation of April, 1865, directing that the clause requiring such payment should no longer be inserted in the grant or patent. The same regulation also authorized the Commissioner of Crown Lands at his discretion to omit the clause reserving mines of gold and silver in patents for lands on the shores of Lake Huron and Lake Superior.

The last of the Regulations for the sale of mineral lands by Order-in-Council was brought into operation in July, 1866, and dealt chiefly with ores of the base metals. They provided for the sale of mining tracts in unsurveyed territory in blocks of 200 or 400 acres; the survey of tracts at the cost of the applicant by a Provincial Land Surveyor; the furnishing of plans, field notes and descriptions showing the connection of a tract with some known point in previous surveys, so that it might be laid down in the office maps of the territory; and payment of the price at $1 per acre at the time of making application. The Regulations also provided that lands in unsurveyed territory should be sold by the Department and in surveyed townships by the local agents, and that in all letters patent for lands the clause reserving gold and silver be omitted.

In 1864 there was a rush of miners and prospectors to regions of Lower Canada in which alluvial gold had been discovered, chiefly on the St. Francis and Chaudiere rivers and their head waters; and in that year, as already mentioned, the Legislature passed the first Act on the subject of Mines and Mining, known as "The Gold Mining Act." It was a statute of 40 sections, drawn up with much nicety and particularity for the mining of alluvial and quartz gold and the protection of miners' rights, for appointment of inspectors of divisions with large powers, for staking out claims of small areas, for licenses to mine, for licenses to mill, for sworn returns of gold taken out, for preservation of the peace, and in short all the trappings which the wit of legislators might devise for conserving the interests of the Crown and protecting the rights and fixing the obligations of miners in a placer diggings gold land.

The rush of miners and prospectors to the Chaudiere Valley was of short duration. Yet the Act of 1864 not only remained with trifling amendments the law of the country down to the end of the union of Upper and Lower Canada; it continued to be the law after Confederation, when the exclusive powers to make laws for management and sale of public land belonging to each Province was assigned to the Provincial Legislatures by the new Constitution, the British North America Act. A good reason for its continuance in Ontario was found in the discovery and working of veins of gold quartz in the county of Hastings, which had been set apart as a Mining Division under the Gold Mining Act on the 17th of November, 1866, ten days after the Commissioner of Crown Lands had received information of the discovery of gold in Madoc.

Under date of November 6, 1866, Hon. Billa Flint, of Belleville, wrote the following letter to the Commissioner:

"MY DEAR SIR.—There is a great stir here at present about Gold in Madoc.

"Already one lot has been sold to Americains for

J. Burley-Smith, M.E., Manager, British Phosphate Co., Glen Almond, Que.

* The Mining Location ticket issued under the Rules and Regulations of the Orders-in-Council, of the 7th October and 2nd November, 1846, contained the condition that if the locatee should neglect to commence and bona fide carry on mining operations upon his location within the period of eighteen months from the date thereof, he should be held to have forfeited the location and license.

about $30,000, and the gold is very rich ; it also begins to be devoloped in other places in Madoc than on lot 18, Con. 5.

" My object in writing is to say to you that I believe it exists in Elzevir, Hungerford and other townships both east and west of Madoc, and my desire is to put you on your guard as to sales of land, as the people are going mad about lands for mining purposes.

" I have for years been satisfied that there was a vein of gold running somewhere about east and west across the Back Country, and have had several specimens from quartz rock for the past five years.

" I know geologists will not admit that we have mineral wealth, but I do know that they cannot tell where mineral is till we find it for them ; and I have no faith in their statements, for when I have given Sir Wm. Logan specimens he wont return them, nor tell me what they are.

The present excitement if kept up for a short time will bring our rocky land to high figures. Lands near this Gold discovery that could have been got for $4 an acre $10 is refused for them now ; this shows the sanguine feeling of both holders and purchasers.

So if there is any good chance, of which I have no doubt, let the Government enjoy for the good of the whole country the benefit by sale or leases.

Yours, &c., &c.,

BILLA FLINT.

Hon. A. Campbell,
Commissioner of Crown Lands,
Ottawa.

On this letter the Commissioner made a memorandum as follows :

" I have no faith in the gold being found in paying quantities ; the Chaudiere country promised much greater riches, but the only persons who have made any money there have been speculators on the delusion of others in the price of lands, and the few who found gold in alluvial deposit. If there be any gold in the townships named by Mr. Flint it is *in situ* and the expense of working it will be found to reduce the affair to the laws of ordinary industrial pursuits. The lands however in the townships named should be treated as gold lands are in Chaudiere —sold at a price of $2 per acre cash, subject to Gold Mining Act.—A. C."

In the first session of the Legislature of Ontario after Confederation the Act of 1864 was repealed, and one known as " The Gold and Silver Mining Act of 1868 " was enacted in its stead,—provision for silver mining having been deemed necessary as a result of discoveries on the north shore of Lake Superior in the previous year. The new features of this Act related chiefly to the granting of licenses to explore and mine for gold and silver within the limits of a mining division and to the levying of royalties. Under the former Act a miner's license was was of two kinds, viz., (1) a Crown Lands license, which upon payment of a fee of $2 per month authorized the holder to mine on any unsold public lands, and (2) a Private Lands license, which upon payment of a fee of $1 per month and after agreement with the proprietor authorized the holder to mine on any private lands within the limits of the division. Under the latter Act the fee for a license was reduced to $5 per year, and it authorized the holder to explore and mine for gold and silver upon any public lands in a division, but subject to the levy of a royalty of not less than two nor more than ten per cent. on the gross amount of gold or silver mined—the rate to be fixed by the Lieutenant-Governor in Council and variable for different mining divisions and different mines according to the yield. Proprietors of private lands were accorded the right to mine for gold and silver upon their own lands, subject to the royalty, and private licenses were abolished.

In the following year this Act was repealed, and there was passed in place of it " The General Mining Act of 1869," a measure which for the first time dealt by legislation with ores and minerals of all classes. It however retained most of the provisions of the former Act, applying them to the occupying and working of " mining claims " under miners' licenses when situate within any mining division, but abolishing the provisions relating to alluvial mines. Larger areas were designated as " mining locations," consisting of 80, 160, or 320 acres, the price was fixed at $1 per acre, and if the locations were in unsurveyed tertitory it was necessary to make a survey and file plans and descriptions as required by the Regulations of 1866. To a large extent, indeed, the old Regulations became in this measure crystallized into statutory law. By this Act, also, all royalties, taxes and duties reserved by any patent theretofore issued in respect of any ores of minerals were declared to be repealed and abandoned ; all reservations of gold and silver mines contained in any previously issued patent were rescinded and made void ;* and it was provided that no reservation or exception of mines or minerals should thereafter be inserted in any patent from the Crown granting any lands sold as mining lands.

These general references to the Act of 1869 will suffice to exhibit the course of the development of mining legislation in our province ; but I pass by the details and take up the law now in operation.

In " The Mines Act, 1892," the Act of 1869 and all subsequent Acts dealing with mining lands, mines and mining, have been consolidated and amended. It consists of four parts, viz.: general provisions, mining locations, mining claims and mining regulations, and for convenience it may best be considered under these several heads.

The administration of the mineral lands is presided over by the Commissioner of Crown Lands, and connected with his Department is a Bureau of Mines, established to aid in promoting the mining interests of the province. The Director of this Bureau acts under the instructions of the Commissioner, and is clothed with all the powers, rights and authority which an inspector or local agent may exercise in a mining division or locality, and such other powers as may be assigned to him by regulation for carrying out the provisions of the Act. In practice the Bureau has charge of the mineral lands in surveyed territory (unsurveyed territory is in charge of the Department), and through it all correspondence and business relating to the selling, leasing and working of such lands is carried on. It also publishes an annual report to furnish information on the mineral resources of the Province, the progress of mining and metallurgical operations, the condition of mines as regards the health and safety of miners and the observance of regulations for the employment of labor.

As in the original Act, any person may explore for mines or minerals on any unoccupied Crown lands, and such lands, if supposed to contain ores or minerals may be taken as mining locations or, if in a mining division, as mining claims. But lands so taken do not now carry the ores or minerals absolutely with the fee simple, as any acquired subsequently to the 4th day of May 1891, are subject to a royalty for the use of the Province. It is an interest which the Crown reserves in mineral lands, and may be regarded as part of the price put upon them by the Act at the time of sale or lease. Accordingly no higher rate of royalty may be levied than is provided by the statute in force when the lands are granted. The royalties are in no case to be imposed or collected until after seven years from the date of the patent or lease (but

S. P. Franchot, Managing Director, Emerald Mining Co., Buckingham, Que.

extended in the case of original discovery to fifteen years), and then they are to be calculated upon the value of the ores or minerals at the pit's mouth less the actual cost of labor and explosives employed in raising them to the surface. In this way and under these conditions, silver, nickel and nickel and copper ores are subject to a royalty of three per cent., iron ore to two per cent., and all other ores to such royalty as may be imposed by Order-in-Council not exceeding three per cent.

Mining locations are required to be of definite form and size, whether they are situated in unsurveyed territory or in townships surveyed into sections or lots. In the territory beyond Lakes Superior, Huron and Nipissing and the French and Mattawa rivers, wherein for the most part the great mineral-bearing formations of the province lie, each location in a surveyed township must consist of a half, a quarter, an eighth or a sixteenth of a section ; and if in unsurveyed territory it must be of rectangular shape with outlines of astronomical bearings, containing 320, 160, 80 or 40 acres, surveyed at the cost of the applicants and connected with some known point in previous surveys, or with some other known point or boundary. The price of such locations ranges from $2.50 to $3.50 per acre, dependant on its distance from a railway and whether it is in surveyed or unsurveyed territory. For locations south of Lake Nipissing the price ranges from $2 to $2.50 per acre. Any greater sum, however, may be charged where a district or locality rich in mines or minerals has been set apart by regulation under Order-in-Council, or the land in such a locality may be temporarily withdrawn from sale.

The applicant for locations has the choice of obtaining a grant in fee simple at the prices named above, or he may obtain a lease at $1 per acre for the first year and 25 cents per acre for each subsequent year, if the lands are in the territory north of the lakes ; if south of the lakes the first year's rental is 60 cents per acre, and 15 cents thereafter. Leases are issued for a term of ten years with a right of renewal for a further like term at the same rental, if the conditions have been observed, and thereafter they may be renewed from time to time every twenty years at such rent as the regulations provide. But the lessee may at any time become the purchaser of the lands held by him, in which case the sum paid for the first year's rental is treated as part of the purchase money. This leasing system appears to be growing steadily in favor with mining men, and a large proportion of the lands now granted for mining purposes are granted under its provisions.

Whether a location is held in fee simple or by lease it is subject to certain working conditions, being an expenditure during the first seven years after the issue of the patent or lease in actual mining operations of $4 per acre where the area of the location exceeds 160 acres, and of $5 per acre where it is of less area ; and such expenditure may consist of labor performed by grown men at the rate of $2.50 per day, or for explosives or other material for mining used on the location. In default of so much work by a *leaseholder* the lease becomes void and the location reverts to the Crown ; in a case of default by an *owner* all mines, mineral and mining rights so revert, but the owner retains all interests in the location as agricultural land.

Under the system of free grants to settlers adopted in 1868, all minerals have been reserved to the Crown, and by an amendment to the Public Lands Act in 1891, they are so reserved on all lands now sold for agricultural purposes. So it has come to pass respecting those lands that two classes of rights are recognized, viz. : surface rights and mining rights. The owner of the surface rights may apply for a patent or lease of the mining rights on his lot, and his claim possesses priority except where there has been an earlier application and a deposit of at least half the purchase price or rental made, or in case of original and *bona fide* discovery of valuable mineral by a subsequent applicant within one month prior to the application of the owner of surface rights. In either case the price per acre of a patent or lease is one half of the rates for a mining location where surface and mining rights are not separated. But a prospector is limited in his right to go upon private land on which the minerals have been reserved to explore it. He cannot enter any portion of a lot used as a garden, orchard, vineyard, nursery, plantation or pleasure ground, or upon which are crops that may be damaged by exploring, or on which is any house, church or cemetery, except with the written consent of the owner or locatee. Neither can the person to whom mining rights have been conveyed go on the land to open it for ores or minerals until he has first agreed with the owner of surface rights for compensation and damage ; but should the parties fail to agree it is in the power of the Director of the Bureau of Mines to order and prescribe the manner in which compensation shall be ascertained and paid or secured, either by an arbitrator appointed by himself or by a suit or action in any county or district court between the parties

It is to be observed that in all sales or leases of mining locations all pine trees thereon are reserved to the Crown, and should the locations lie within a timber limit the holder of a license to cut timber on the lands may enter upon them and cut and remove the trees. Yet although the patent or lease expressly reserves pine timber, the owner or lessee may cut and use all pine and other trees needed for building, fencing and fuel on the land, and for any purpose essential to working the mines upon it, as well as cut and dispose of all trees required to be removed in clearing the land for cultivation. But a lessee is restrained from using pine trees for fuel other than dry pine, and should he intend to clear any portion of the land for cultivation, he is required to give the holder of the timber license three months notice so that he may remove any pine on the area to be cleared. If at the end of that period it is not removed the lessee may cut and dispose of all trees on the land to be cleared, but subject to payment of the same dues as are payable by the holder of the license. The privileges of the lessee are also circumscribed in another particular. Should he during the first ten years seek to cut timber other than pine upon his location, beyond what is needed for building, fencing or fuel, or in the course of actual clearing for cultivation, or for any purpose essential to the working of the mines, he must first apply for leave to the Commissioner of Crown Lands, who may grant authority to cut the timber and fix the rate of dues to be paid upon it. But inasmuch as a lessee may forfeit and abandon his title to a location by the simple process of neglecting or refusing to prepay the yearly rent, it is not reasonable that he should be treated with the same liberality as an owner in respect to the timber upon the land. The important point is, however, that both owner and lessee of a mining location are entitled to the free use of all the timber upon it which may be wanted for mining purposes, while the owner is entitled to the free use of all timber, excepting pine, upon it for any purpose. The owner or lessee of mining or underground rights has of course no claim to use of the timber upon a location which, as tar as it goes at all, goes with the surface rights.

The portion of the Act which relates to mining claims and the manner of acquiring, holding and working them is for the present inoperative, inasmuch as no tract of country has been declared or set apart as a mining division. The reason no doubt is that circumstances have not arisen to call for utilising the system for which it provides, either by reason of the distance of mining fields from surveyed or settled territory or the discovery of fields very rich in gold or other valuable ores were small areas would satisfy the desires of mining men. Mining locations are preferred, and there is not a demand for mining claims. Yet it is possible that the demand may arise in some portion of the vast mineral-bearing formations of the Province, and

*It has been stated that most of the patents issued down to the end of 1823 reserved for the Crown mines of copper, tin, lead, iron and coal, as well as of gold and silver; but inasmuch as only the two last named were by the Act of 1869 deemed to have passed with the lands to the owners in fee simple, it may be assumed that the right to the others in all cases where the reservation was made in the patent is still in the Crown.

in view of that contingency it is well to have a provision ready at hand, to which effect may be given at the will of the Executive.

In the Mining Act of 1864, the area of a claim which might be staked out by one person holding a license was less than half an acre, and by a company of persons not more than about 2⅔ acres, and these areas were doubled by the Act of 1869. The Mines Act 1892 provides for staking out by one person a claim 660 feet along a vein by 330 feet on each side of it (about 10 acres) and by a company of persons a claim not exceeding at the maximum 1320 feet along the vein by 330 feet on each side of it (about 20 acres). But no person has the right to stake out a claim or to mine it who does not first obtain a miner's license, for which the fee is $5, and pay a year's rent for a claim at the rate of $1 per acre. A license is renewable only upon payment of the fee and of the annual rent for a claim, and the tenure of a claim depends besides on stringent working conditions. Adequate provision is made for the protection of miners' rights in a division, and for the enforcement of law and order under the authority of an Inspector.

The fourth part of the Act is chiefly designed to provide for the health, safety and well-being of miners through a proper and careful observance of Regulations for the working and management of mines; but as these follow pretty closely the British Mining Regulations any enumeration of their features would be superfluous here. The Inspector whose duty it is to look after their enforcement finds that owners and officers of mines are with rare exceptions desirous of doing liberally all that the Regulations require, and it does not appear that the employed classes have a grievance under them for which legislation could effect a cure.

MR. MCKAY, (Sault Ste. Marie), said—The objections, in my mind, to the levying of a royalty are, first, that it is merely a means of furnishing a revenue to the province; and second, that the bonuses and dues from pine limits will net the same amount to the province. Further, the price of mining lands at two and three dollars an acre for the portion of the province unsold would amount to about $150,000,000. From the standpoint of encouraging the development of the country, a high tax on land per acre would be preferable, as it would discourage the speculator and would not tax the company or individual in accordance with the development of the resources of the country. If a 3 per cent. royalty is not a high tax, we object to the Government singling out one specific industry to be the object of a direct tax. It is this fact that tends to discourage American or foreign capital to invest under the Ontario Mining Act; for the inventor who discovers a certain method of bringing together a certain material, for which he obtains from the Dominion Government, a patent, should be the object of a royalty as much as the explorer, who discovers the existence of mineral wealth. The inventor usually is paid by royalty, and it might be argued on the same lines as those which are urged on behalf of the royalty on minerals, that he should contribute to the province. Inventors would unanimously object to such a royalty being levied; and the answer of some manufacturers that he would not object to pay a 3 per cent. royalty on a good patent, does not dispose of the question any more than does the answer from one of our mine owners who operates under the old Act that he would not object to pay a royalty of 3 per cent. The royalty either comes out of the pocket of the explorer or the inventor; or out of the pocket of the capitalist, who uses the invention or the mine for the benefit of the public.

The mining industry requires every encouragement, and as the Royal Commission has said, the most legitimate means by which the people can really enrich themselves is hy extracting the wealth from mother earth direct. The liquor traffic, in my opinion, out of which millions of dollars have been made by Canadians, should be made the object of additional taxation rather than mining.

PROF. C. G. RICHARDSON, Toronto.—If I am not mistaken, the Act especially provides that this royalty is in lieu of all taxes?

MR. A. BLUE.—Not in lieu of municipal taxes; and it is of course subject to the tax of one cent per acre, which the law imposes for local improvement purposes on lands which are not within municipal districts nor in incorporated townships.

PROF. C. G. RICHARDSON.—With the principle of royalty I have a great deal of sympathy. The only objection I take to the Mining Act of Ontario is in reference to the clause reserving from the miner the use of the green pine. This has caused a great deal of antagonism in the past between the miners and prospectors, and the holders of timber licenses. It is unfortunate that this should have occurred, since in very many instances fires have been set, no doubt wilfully, or at any rate through carelessness by prospectors when searching for minerals. The only way, so far as I can see, of securing immunity from danger in prospecting a wooded country would be to make the interest of the prospector identical with the interests of the lumberman and the interests of the country; that is, in the preservation of the timber from fire. I think it would be well if the prospector could be assured of the pine.

MR. BLUE—Well, he is assured of that right for mining purposes.

PROF. RICHARDSON--Only to use it for building and clearing, not for roasting. Green pine for roasting is worth its weight in gold.

MR. BLUE—The question has never been raised. That is justified in the Act.

PROF. RICHARDSON—Green pine?

MR. BLUE—Well, I think so.

MR. IAN. CAMERON, (Mgr. Dom. Mineral Co., Sudbury.)—I think the lumberman has got the right to use green and dry pine for his uses.

MR. BLUE—Under certain circumstances he has. Any location has the right to all timber upon it for any purpose; because most of the country up there is under timber limits. Timber limits have been disposed of here, and were disposed of before any minerals were discovered in the country.

MR. B. T. A. BELL—Doesn't the Mining Act make provision for inspection?

MR. BLUE—Yes; once or twice a year, or as often as may be necessary.

CAPT. PENHALE—I do not believe in the imposition of a royalty. I consider the Government should give greater encouragement to miners; for the minerals are of no use until they have been taken from the ground by the miner. I think the Government should remove every obstruction to mining. If they did, they would get more money out of the country, and would settle it rapidly.

MR. BELL—Capt. Penhale must not forget that up to the passing of the Act the mining legislation of Ontario was in a very bad state. The Government had sold lands for $1.00 and $2.00 an acre, and the result was that very large tracts of these valuable lands were locked up, and are locked up to-day, by speculators who hold them at large figures practically prohibitive to the development of mining. The Government is quite right in asking a fair price for lands. The idea of giving away valuable mineral land for $1.00 or $2.00 an acre without any condition as to its development was absurd. I think that while the Ontario laws may in some particulars require revision, they are in the main fair and equitable.

CAPT. ADAMS—It is important to notice that a feature of the present mining law is that no royalty will be levied on an industry for seven years, which gives a new industry a chance to establish itself. I think most

W. H. Irwin, Anglo-Canadian Asbestos Company, Montreal.

mining men will agree that if an industry lives for seven years it ought to be in a pretty healthy state. I think that is an admirable feature.

MR. IAN. CAMERON, (Mgr. Dom. Mineral Co., Sudbury)—I may say we have no objection whatever to pay the Government a 3 per cent. royalty if the mine can afford to do so. I think the Government is quite justified in selling its lands at any price it may see fit to put on them. If it chooses to sell lands at $3.00 or $3.50 an acre and say: "after seven years you shall pay a 3 per cent. royalty of the net profits of the mine," it is in my opinion perfectly fair. The State ought to have the royalties. I may say that in the last twelve months I have been asked by some six or eight people if my company would buy properties, and have been asked to pay from $20.00 to $1,000 an acre, and above that a royalty at from 25 to 50 cents a ton. I see no reason for the grumbling about a 3 per cent royalty. It is a bagatelle.

DR. SELWYN, Director Geological Survey.—In my opinion, a tax should be put upon the transfer of mining properties. In very many instances lands have been bought for one or two dollars an acre, and the owners have afterwards sold them for $150,00 to $200,00 an acre; and these men, after making a large deal, simply walked off with their money in their pockets. So, where a man sells his claim in that way for $50,000 or $100,000, he should be made to pay a tax to the Government. Besides, very often those men retain an interest in the properties they dispose of.

MR. J. BURLEY SMITH, (Glen Almond, Que.)—I would ask if it is a fact that when the Government grants a mining right, it is done with the idea or intention that the property shall be mined? Otherwise, they could not expect to derive a revenue from the royalty on that mine. If the Government leese lands to people who do not work them, it is quite evident that the law itself is inoperative; but a way to get over that, would be to make a miner take so much land on mining rights conditionally that he should work it, and make him also pay a certain sum for a certain number of years. The miner then knows that if he does not work the land it will not pay him to take it.

MR. R. G. LECKIE, (Londonderry, N.S.)—The Government is willing to dispose of its property at so much per acre. They will take no responsibility in exploring or developing these lands. It leaves that entirely to the purchaser. For instance, I have taken up several square miles of land in Nova Scotia, supposed to be inlaid with coal. We have spent probably fifteen or sixteen thousand dollars upon these lands. The coal supposed to exist here has not been found, and that money invested has practically been lost. The Government will not refund us anything; then we go on again, and purchase or lease other lands; and repeat perhaps, the same thing. If we are not successful, we lose our money; and if successful we ought certainly to have the return sufficient to cover the great risk we run of losing our capital. The Government will risk nothing; but leaves all the expenditure and risk of loss to the miners, or "advanturers", which is the English term.

Notes on the Legislation Affecting the Working and Regulation of Mines in Nova Scotia.

MR. H. S. POOLE, (Stellarton).—In Nova Scotia the Provincial Legislature has besides the public weal the interest of a landlord in the minerals to influence the tenor of its Statutes relating to mining. These two interests have had added to them a third, which is political.

The earlier legislation had in view almost exclusively the extension of the industry and the encouragement of capitalists to develop the mineral resources of the province; this is especially noticeable in the debates of 1866 when members on both sides of the house unanimously agreed for these express purposes to grant to lessees the right to have their leases renewed on the same terms, conditions and covenants as contained therein for four periods of twenty years each. The form of lease adopted approximated closely to one very generally employed in Great Britain, and reserved to the landlord the right to inspect the mines and to object to bad practice. This reservation was in conformity with the Mines and Minerals Act which expressed alone, until the year 1873, the desire of the country to foster mining and to control the methods and practices of the miner.

This Act went on to define the terms under which mines and leases of areas could he held and the fees to be paid. A discussion of its requirements and the modifications that have been made to it of late is left to others.* Here it is proposed to alone consider the practical branch, which in the Act in question was limited in Section 5 to the appointment of an Inspector and empowering him to examine and report to the Commissioner of Mines. It imposed but one penalty, forfeiture of lease, for all shortcomings on the part of the lessee, be they great or small; the result was that the Inspector of Mines was practically powerless to enforce any rules that good practice elsewhere commended. The writer realized this in 1872 on his appointment to the office of Inspector, and he then recommended that an Act based on the lately amended English Mines Regulation Act should be introduced, and one somewhat less stringent was with slight amendments passed the following year.

The desirability of such a Regulation Act appeared to be accentuated by the Drummond explosion, with a loss of 59 lives which followed almost immediately and before the Act came into operation. Its stipulations were almost exclusively in favour of life. It began by including all openings for mining purposes as subject to its provisions and then in provisoes made certain exemptions. It divided mines into two sections, metallic and non-metallic:

It defined who were responsible for carrying out its provisions:

It regulated the employment of boys:

It touched on the Check-weighman question:

It required two outlets fitted for the passage of men:

It stipulated for official returns, frequent surveys and reports of accidents:

It empowered inspection:

It provided for Coroner's inquests:

It laid down the well known General Rules:

It furnished a means for supplementing these by Special Rules:

And it imposed penaltics for non-compliance.

The original form remained unchanged for many years and the first amendment of moment had to do with the restriction of operations under the landwash. This was felt necessary in the view of the very large mileage of workable coal that lay off the foreshore of Cape Breton and which can only be ultimately won by reserving access thereto.

When in 1880 the Foord pit explosion with a loss of 43 lives followed an irruption of water which occasioned the loss of other six seemed to call for further legislation, amendments looking to making inquisitions more searching if possible than before were introduced, at the same time the foundation was laid for more frequent inspections, which it may here be mentioned have developed into regular monthly inspections by deputies; the office of Head Inspector being merged with that of Deputy

*The expected papers on the Mines and Minerals Act of Nova Scotia were not read at the Convention.—(EDIT.)

Commissioner of Public Works and Mines an office which alone carries with it a multiplicity of duties.

Authority was also given for the establishment of a Board of Examiners and the granting of certificates of competency to underground officials.* This portion of the Act has been since then expanded, mining schools have been established and facilities furnished in each coal district for aspiring young men to more readily acquire the theoretical knowledge demanded at the examinations. The full benefit expected to result from this step has not yet been felt, the present state being rather one of transition, but the ultimate advantage of having even a rudimentary theoretical knowledge added to the practical work of coal mining cannot be doubted, and the benefits are already most marked.

A minor evil incident to a transition stage is experienced in the tendency of those holding certificates to regard them as credentials of special fitness. This is of course a mistake, a certificate is no guarantee that the holder is a man of tact, of common sense, of resource, is capable of directing men or is in short a good pitman; all it does is to certify that the holder has actually had some practical experience, and possesses some of the qualifications that are desirable for one engaged in the management of a pit. In time however this difficulty should cease and a sufficiently large number of certificated men be available from among whom selections may be made of those possessing, besides a certificate, the more valuable practical qualifications essential to a successful pit manager. In this connection remarks last year by Mr. McKay, Supervisor of Schools, Halifax, on "School Preparation for Industrial Pursuits" are worth repeating:

Of one hundred pupils who enter our common schools, said Mr. McKay, only 33 per cent. complete the sixth grade and 20 per cent. the eighth grade. Nine per cent. enter the academy and four per cent. remain three years. Of ten who enter the academy, one matriculates into college with a view to one or other of the learned professions. The other nine leave with a more positive dislike for manual work than when they left the common school. Some of them will therefore teach, and others will become clerks, bookkepers, etc. Why should education forces and government aid be so largely expended in preparing the few in Latin, so as to enable them to matriculate in medicine, law or teaching, while agriculturists comprising 45 per cent. or the working classes, are left ignorant of the fundamental principles of chemistry, botany and the use of tools? Why are artisans, comprising 28 per cent., left without a knowledge of industrial drawing? These subjects are not only of more importance to these classes than Latin is to professional men but also of more practical utility to all classes and at the same time, in the opinion of educational reformers, better adapted as educational instruments for mental discipline.

Mr. McKay then went on to consider what constituted the best school preparation for industrial pursuits. Seven things, he thought, were necessary: A thorough Kindergarten training; a sound physical education, good health and muscle; a knowledge of reading, writing, and arithmetic; a knowledge of history and economics; a knowledge of the physical, chemical, and physiological forces of the material world; drawing; and manual training. In concluding he reminded his hearers that the literary classes had so far directed education, the industrial classes would do so hereafter.

But to return to our legislation, the intention of the numerous amendments following those of 1881 which related to raising the standard of official knowledge was obviously good, but we as a people have a very general belief that in legislation lies the panacea for almost every ill, and hence it is not uncommon to find Acts drafted by those untrained in legal phraseology and with limited experience, though evidently well meaning, accepted and as freely passed by the Legislature. The statute book is full of Acts hastily prepared and revised in the same laudable spirit, it may be even amended by two and sometimes three separate Acts during the same session. The various attempts to straighten out the clauses relating to certificated officials and their duties are cases in point.

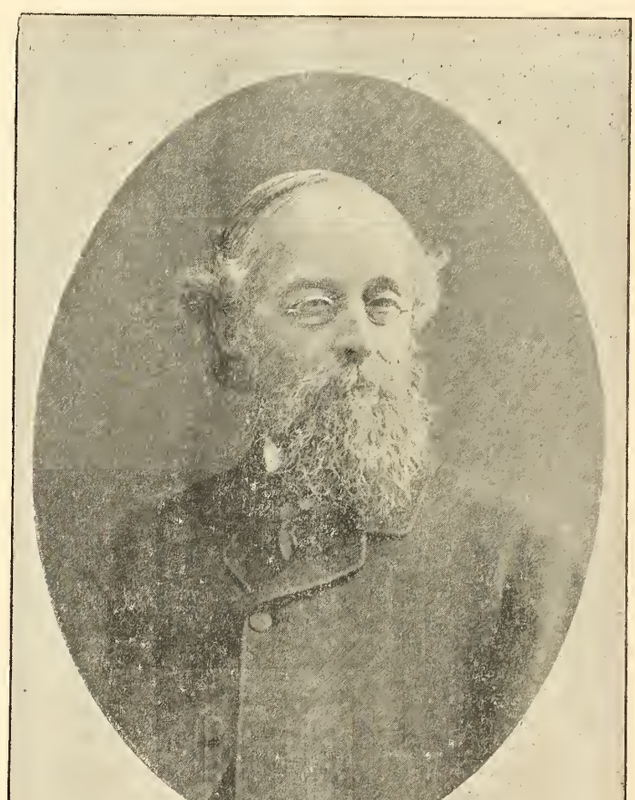
First, the Act of 1881 stated that after a fixed time it shall not be lawful for any one not having a certificate of competency to be employed at any mine in this Province. The time was subsequently fixed for January 1st, 1884, but although there was the Act applying to all mines, gold, coal and iron, and strictly read to all workers in mines, boys and men without exception, no attempt was made to enforce this law. Again there remained for years on the statute book, clause 44, ostensibly framed to reduce the numbers of certificated officials in mines of limited extent, but which actually added to the number of officials required for the class it was intended to relieve, by being made to read "but the operations below ground shall be under the charge of persons holding certificates as underground managers and over-men." Strictly enforced, this, in some cases, would have required four officials at least to supervise the operations of even as few as two working men.

*Chap. v., 1881.

When representations have been made by those whose liberty of action was threatened to be restricted in consequence of the Act bearing a construction beyond that intended, the answer has been good naturedly made, "the intention is evidently otherwise, and an amendment *next* session can correct the ambiguity."

Or again, on complaints that important alterations have been made to the mining Acts without those chiefly affected having an opportunity of studying their bearing prior to their passage through the House, they have called forth the remark, "Oh, the Government cannot prevent any member of the House from bringing in an amendment to any Act." This may be generally true, but as there is a special department devoted to mining matters under the direction of a member of the Government, it has been urged, and it is thought fairly, that all Acts and amendments relating to mines should invariably be Government measures. Not only so, but that no Act should be sprung on the mining community towards the close of a session when it is impossible to carefully consider it, but rather that all Acts relating to mines should be prepared during recess and be subject to the criticism of all classes likely to be affected by them.

The Department of Mines has experienced officers capable of weighing the advantages expected to be gained by any additional legislation, putting on the one hand the restrictions to be imposed and on the other the possible cost to the industry, and the attitude of this Department towards any proposed legislation should be clearly established, as is understood to be the case in England.



Dr. A. R. C. Selwyn, C.M.G., Ottawa, Ont., Director, Geological Survey of Canada.

The strong faith in the efficacy of the mere passage of legislation leads to the assumption that when an amendment to the mining law is proposed it is evidence of its necessity, and our legislators are apt to consider the opposition of mining men to be expected and rather indicative of the necessity than otherwise for the additional restriction. They therefore say let us give the bill a trial, and if it doesn't suit why we can repeal it. As a seafaring people we know the benefit derived from the law requiring masters and mates to hold certificates—let us apply it to our mines as is done in other countries, and not only require the head pitman to hold a certificate, but let us go further and include all deputies, gas triers, shot firers, and even drivers of hoisting engines. This has been done, but the possible combination of circumstances and conditions has not been carefully worked out and made clear in the Act. In its present form, the Act suggests several questions on the intention respecting officials. How many offices can one man fill? Does a certificate of higher grade legalize the holder to perform the offices appertaining to a lower?

Again whether the object of the Act is solely to ensure the employment of suitable men or has it in view to find employment for the greatest number of officials. This question arises when an attempt is made to follow the law in a small mine where the full train of colliery officials contemplated by the Act does not seem warranted. The list of officials besides the owner and agent reads as follows: manager, underground manager, overman, night examiner and shot firer.

It is a grave question whether the advantages expected to accrue from certificating shot firers and firemen such as gas triers and night examiners are not more than met by the disadvantages the complications to which the law in its present shape give rise, and the infractions of the letter of the law when temporary substitutes have unavoidably to be made of non-certificated men. In making appointments for these offices who can know the fitness of men so well as the mine managers? A Board of Examiners certainly cannot. Take the case of a shot firer who must not only know the law relating to firing shots and the use of explosives underground about which he can be examined, but he must know the coal in which the shots are to be fired, how best the shots should be placed, and whether the pickman has "properly worked" the coal for the proposed shot. Especially must he have back bone enough to refuse to fire it when the conditions are not favourable. To judge of this fitness personal knowledge is essential, not mere acquaintance but knowledge of a man at his work, and who has that so well as the manager of the mine? And yet under the law the selection is no longer entrusted to this official of all men the most interested in the appointment of fit persons, but it is subject to the approval of whom? Not even of a Board of Examiners for there is no written examination, but of a local miner, who may not be the holder of an underground manager's certificate of competency.

That this was intentional when the Act was framed is not for a moment suspected and yet it is the result when the law comes to be put in operation. It goes without saying that the management of a mine will appoint the best available men to the permanent positions and the best men for substitutes when such are required. Then again for such an occupation as driving an engine, book learning it has been contended does not add to the efficiency of a man if anything rather the reverse, as it leads to abstraction and inattention to immediate surroundings. And it may be doubted if in this particular case the stipulation requiring a certificate is worth the annoyance it may at times occasion; at any rate in its present form, as no provision has been made for the temporay substitution of uncertificated men during the unavoidable absence of the regular drivers.

One anomaly connected with the law respecting the certification of officials having to do with mines has yet to be mentioned. In the Statutes of 1885 it was required that future Deputy Inspectors of Mines should be holders of certificates to be granted subsequently to examination, but this clause was on a later revision thought to be a mistake and deleted.

Then it would seem, so confident are we in Nova Scotia that the mining world outside our own, which is almost insular, can teach us no new thing, that our legislature has felt justified in emphasizing this feeling and guarding our interests from possible inferior practice and talent, by debarring any one however eminent he may be in his own country from practising here as a Colliery Manager, that is at least, until he has ripened his foreign experience by a three years course with us and obtained a certificate from our Local Board of Examiners.* An exclusiveness that in some branches of trade and art has not elsewhere always led to the most rapid development of a country or the most happy results.

Attention may also be directed to the fatherly regard for colliery boys under 16 years of age, employed not only underground but above ground. No objection can fairly be taken to the restriction of the hours of labour below when the work is regular, but, as the occupations of boys about a colliery above ground are healthy, far more so than those in close factories, and certainly not less so than those about metallic mines, in all cases exempted from the provisions of the law it has been urged that to be consistent the hours of labour of boys in factories and other industries should be also restricted. Until this is done the purity of the sentiment that induced the addition of this clause must be questioned. At the present time it is exceptional to find one among the workmen who is in favour of restricting, especially on the surface, the hours of boys between fourteen and sixteen years of age to 54 hours a week.

It is of course very desirable that the apparent contradictions in the Act should, as far as possible, be eliminated, not an easy thing to do even when the interested parties are agreed, and still less so when there is disagreement and amendments are compromises. Among the changes that might be made, it is desirable that small mines and simply worked mines should not be obliged to employ a greater number of officials than the necessities of each case require, and which would be demanded were it not for the wording of the Act. And that the exceptional requirements of more complex mines

*But an English certificate is accepted in lieu of local experience, still the holder must undergo a local examination.

COUSIN JONATHAN TAKES IN THE RINK.

Being a sketch from life of a member of the American Institute, who basely counterfeited the genial President of the American Institute of Mining Engineers, at the Carnival, Victoria Rink, Montreal, 23rd Feb., 1893.

should be met by additions to the Special Rules as provided by the Act.

It seems desirable that the law should clearly legalize the practice of the manager and the underground manager being one when the duties of offices can be assumed by one person, especially as the definition of the duties attending these two offices draws a distinction with a difference that has yet to be legally defined.

It might be well if the definition of "overman" were changed and made to read the officer in charge in the absence of the underground manager.

And it would appear more consistent on the part of the Legislature if, for the welfare of the working man he is when engaged at the coal mine to be paid fortnightly, that he should be equally protected as regards the payment of wages when working for large employers of labor.

MR. POOLE—I bring forward these notes with the hope that by bringing them to the attention of our own legislature, amendments may be produced. I thought it better to take the bull by the horns, to discover whether we are likely to get this legislation or not, and therefore, the Mining Society of Nova Scotia expressed its desire that a representative of the Department of Mines or the Government might attend at this Convention. The Inspector was unable to be present, owing to pressure of business; but the Premier of our province having occasion to come to this part of the world at this time, has most kindly undertaken to appear on this occasion and to profit by this discussion, which it is hoped will take place on this and other matters. Those who know our silver-tongued orator can appreciate how venturesome it is of me to speak in his presence, as any one who has passed through the fire of Moloch, in the County of Pictou, can testify.

CAPT. ADAMS—I think that Mr. Poole's able exposition and representation will tend to make us all good anarchists. I have much pleasure in calling upon the Hon. Mr. Fielding to address the meeting.

HON. MR. FIELDING—I have the pleasure of knowing a number of the gentlemen present this afternoon, and I trust that they know me well enough to feel that I do not presume to enter upon a discussion of mining laws in the midst of a body of mining gentlemen, the most of whom are ever disposed to think that all mining laws are bad. Far from finding fault with, I welcome Mr. Poole's criticisms most cordially. I congratulate him heartily, and join in expressing my regret that Dr. Gilpin, our Inspector of Mines, has not been able to attend. I do not wish for a moment any one to assume that I am present as a substitute or as a representative of the Government, in any capacity, to discuss mining matters. I had occasion to come this way, and combining pleasure with my business, I accepted the invitation to attend this Convention; and, as the Mayor of Montreal said the other evening, "I am here."

There is a general tendency to grow in this world; and I admit that the laws of some years ago are not good laws now. If we are never to have any changes in these matters, I should get along very well; but the public at large seem to think that some legislation is necessary; and naturally we revise these laws when revision is considered essential; though sometimes we do not make them any better than they were before. But the public require that they should be revised all the same.

There is no province in the Dominion in which the mining community have received fairer consideration than the Province of Nova Scotia. We must deal with the truth that in former years laws were moulded at the will of mine owners; but at the present time there is a disposition to recognize that there are more than mine owners to be considered in this matter, and we must speak plainly now. The working-men in the country have in the past few years made their voice heard and felt in the legislation of Nova Scotia; just as in the legislature of the civilized world; and in the desire to meet their reasonable wishes, some mistakes have been made. There is now in the Parliament of Nova Scotia a representative of the working men who is giving special attention to what he considers their best interests; and some of the legislation complained of by Mr. Poole is attributable to the evidence of that gentleman. It is possible that in his efforts he has asked the attention of the legislature to some measures which were open to debate there; and which other members, not being so well informed on the matter, may not have gone so deeply into. I am willing to learn, and the purpose of my presence here to-day is not to presume to teach this gathering of mining men, even about the mining laws of Nova Scotia.

There was a tendency on Mr. Poole's part to undervalue the certificates. It is quite possible to under estimate; but these certificates should be received broadly. A medical man is not necessarily a man of great skill. He gets his deploma and a big red seal, and he is sent out to cut our leg; if we are fortunate or unfortunate to fall into his hands.

These certificates only prove that a man has received a certain measure of training, and if that man possesses brains and judgment, he should be qualified to do the requisite work. Perhaps the strongest point made by Mr. Poole is that all legislation in respect to mines should be brought about, not in a haphazard way, but that it should pass under the view of an officer of the Government of the province. But that is a matter more likely to commend itself to members of the province than our friends of the United States. Perhaps the distinction between the British and American Governments in this matter is that the legislation in British provinces is largely directed by the cabinet, and in many of the most important things the Government assumes the direction and the legislation; and in the main, that has a wholesome effect. But it is quite possible there to overdo things; and the private members in Parliament are disposed perhaps to think that the Government may want to interfere with private liberty with which all Governments should be careful not to interfere. But in the United States you have no Government in Parliament. The Government is *outside* of Parliament, and that is on the floor of Congress. Every member has the same right as his neighbor; every private member has the liberty of introducing a bill upon any subject which is in his judgment for the benefit of the people. With the general tone and temper of Mr. Poole's criticism, I have no fault to find. I know he has no object but the improvement and protection of our mining legislation.

I can assure him that when the next session of our legislature comes round, if he and his brother associates in mining will come as in the past and meet the members of the Government, they will find every reasonable proposition they make met in the same spirit which has been manifested in the paper Mr. Poole has read this afternoon.

MR. POOLE—I would add a word or two which I think may be considered due to myself. I did not intend to question the efficiency of the certificates given to men who were examined. I took objection to the granting of certificates without an examination, and the leaving of the decision to men whom I did not consider were quite so competent to judge of a man's fitness as those who were in charge of mines. One word more, I contend that the law of 1872 contained within its provisions that which would have enabled, had it been put into practice, desirable amendments to be made to the Mines Regulation Chapter from time to time, as occasion might seem to require. The propositions I have reference to are the clauses relating to special rules; which clauses, so far as I know, have never been put into practice. I contend that if the workingmen have grievances, they can bring the matter to the Government, and the discussion can follow between the two parties supposed to be interested; with the Government as arbitrator. This I think a better system than bringing the matter on the floor of the House at the busy season of the year, when it cannot be carefully considered. After that, the Act as it stands is quite sufficient to meet all such cases.

MR. CHAS. ARCHIBALD (Gowrie Coal Co., Cow Bay, N.S.)—I regret that I was unable to be present when Mr. Poole began to read his paper, and that consequently I did not hear the whole of it read. But I am very thankful for hearing what I did of it, and for hearing Mr. Fielding's able speech. It was very good of the Premier to tell us that the Government of Nova Scotia would in the future, as in the past, meet the mine operator in a broad spirit; and perhaps after the discussion today, he will be more incllned than ever to do so in regard to these matters. What I want to speak about, is the certificates. The laws are, of course, very good; but we who have to mingle with the men who get these certificates, have an opportunity of knowing what these examinations do for them; and we are perhaps better able to judge than others who know nothing about mining; and though I am very favorably inclined to the idea of educating men up to a standpoint of underground management, I think the province has not done enough towards educating these men. The fault I find is, that in our section of the country (Cape Breton) we find men taken from their places where they have been merely miners, and in very many cases unfit to do any work other than mining; they do not know how to put timber up properly; they know nothing in connection with underground work. Yet these men from advantages in their previous life are able to go to school for perhaps two months, and in certain cases, they are passed by men who never worked in a mine; but they get through and are examined by men who could not pass an examination themselves. Therefore, I say, you cannot expect these men to be fitted for the positions for which they get certificates. However, I have no doubt, when these matters are put before the Government, they will help us out, and I feel sure that the paper read by Mr. Poole will be the means of improving this particular point in connection with mining legislation in the province of Nova Scotia.

Notes on the Drummond Colliery, Westville, N.S.

This was the subject of a contribution from Mr. Chas. Fergie, M.E., manager of the Intercolonial Coal Co., at Westville, N.S. Mr. Fergie, owing to illness, did not reach Montreal until the end of the week, and the paper was read in his absence by the Secretary. It was as follows:

This property situated at Westville, in the county of Pictou, Nova Scotia, and owned by the Intercolonial Coal Mining Company of Montreal, has a coal area of 2¾ square miles. The main and second seams are worked, the third and fourth being intact. The second seam is only in process of being opened up, and the following notes refer to the main seam alone, which is worked by slopes, size 12 ft. by 8 ft., having an average dip of 16 degrees, and are 4,200 ft. long; the fan shaft is situated to the south of these slopes at a vertical depth of 70 feet and is 10 ft. by 8 ft. The coal is good for steam and household purposes and makes an excellent coke. The No. 1 slope is used exclusively for hoisting coal, the No. 2 for lowering and raising men, also for dropping down timber, materials, etc.

WINDING.—The winding and hauling engines are set back in direct line with the slopes. No. 1 winding engine has two horizontal cylinders 28 in. x 60 in. x 60 in. stroke; balanced piston valves; pair of plain drums 10 ft. diameter x 3 ft. 6 in. wide with independent action. The Lane friction gear is used; hauls 12 boxes, each containing 1,344 lbs. of coal up 3,700 ft. in 3 minutes.

HAULING ROPES.—These are of plough steel, 1 in. diameter, "Lang's" patent, have been running steadily for 20 months, and are now apparently as good as when put on.

BOXES.—These are of wood, size 4 ft. 2 in. x 2 ft. 2 in. wide by 2 ft. 6 in. deep. The wheels are steel, 12 in. diameter, fast to the axle, which is 1⅝ in. diameter, and also steel; the bearings are inside; the gauge is 2 ft. 8½ in.; 300 boxes are used in and about the mine and the greasing is done on the surface. To avoid waste of oil and grease, and to provide a continuous and sufficient lubrication, a self lubricating pedestal, lately protected by the writer, is being introduced with good results.

NO. 2 WINDING ENGINES are a pair of 16 in. x 36 in., V friction geared 2 to 1; drums 8 ft. diameter; work singly or connected. The rope used is ⅞ in. of crucible steel.

BOILERS.—There are 5 egg-end steel boilers, each 30 ft. x 3 ft. 6 in.; the working pressure of steam is 80 lbs., 2 Cornish steel boilers 30 ft. x 5 ft. 6 in., flues 1 ft. 10 in. diameter, working in conjunction with 1 "Heine" boiler of 200 h. p., the working pressure of these is 100 lbs.; this latter boiler, is a quick generator of steam, accessible at all points, costs little to erect, and will burn the smallest slack or duff. Steam is conveyed down the mine by 5 in. cast iron pipes having spigot and faucet joints, for the first 2,000 ft., afterwards by 3 in. wrought iron flanged pipes to a point 3,700 ft. on the slope. The latest pipe provided for the lower workings are 3 in. wrought iron tubing flanged at ends, with loose cast iron spigot and faucet flanges.

PUMPING.—Three steam pumps are employed. No. 1 is "Knowles" direct acting compound plunger pump, cylinders 8 in. and 14 in., plunger 6 in., stroke 24 in.; independent condenser; vertical lift 347 ft., column 10 in. cast iron. No. 2 is a "Northey" improved steam pump cylinder 14 in., plunger 5 in., stroke 12 in. with separate condenser; vertical lift 500 ft., column 4 in. cast iron. No. 3 is also a "Northey," 12 in. cylinder, 4 in. plunger, 12 in. stroke; vertical lift 80 ft., column 3 in. wrought iron.

VENTILATION.—The ventilation of the mine is produced by a fan of the Guibal type, constructed by G. W. Snyder, Pottsville, Pa., and erected July 8th, 1875; it is 20 ft. by 7 ft. wide, driven direct by an engine 16 in. by 24 in.; the engine and fan running at a speed of 45 revolutions per minute produces 100,000 cubic ft. of air per minute, with a gauge of $\frac{7}{16}$ in. A steam jet is provided in case of accident to fan, and is capable of producing 25,000 cub. ft. of air per minute.

UNDERGROUND HAULING.—The haulage on the south levels, from which two-thirds or more of the output is taken is by tail-rope; the engines, built at the colliery, a pair of 8½ in. by 6 in. stroke; geared 7 to 1; drums 4 ft. by 2 ft. 6 in. wide; hauls 22 boxes each trip; average speed of boxes 6 miles per hour; rope crucible steel ⅝ in. diameter; boxes run on T rails 18 lbs. to the yard.

COKE OVENS.—There are 20 bee-hive ovens, each 12 ft. diameter by 6 ft. high: a charge consists of 5 tons of unwashed coal, and which has passed through an ½ in. screen; ovens are drawn every 72 hours; average yield of coke is 2 tons 16 cwt. per oven per charge. A "Sheppard deadweight" coal crusher has just been erected, capable of crushing 12 tons per hour; the coke produced from this crushed coal is a great improvement on that previously made, it is stronger, brighter in appearance, more uniform in texture, and has more of a metallic ring when struck. A "Robinson" coal washer is about to be erected, and this is expected to remove a lnrge percentage of dirt in the slack, and consequently reduce the ash in the coke.

LIGHTING.—The work-shops, engine-houses and bankhead are all lighted by the incandescent electric light, supplied from a dynamo, placed in the machine shop, and which is driven by a counter shaft from the shop engine; its capacity is 75 lights of 16 candle power. No open lights are allowed in the mine; the lamps used are the Marsaut and Clanny, the latter one being replaced by the former.

SCREENS.—The ordinary fixed screens are used, arranged to make Round, Run of Mine, Nut and Coking coal. The height of the bank-head is 25 ft. length of screen bars 14 ft. set at an angle of 29 degrees. To avoid breakage, and allow for more thorough picking and cleaning, the coal, after passing over the screen bars, slides on to an apron shewn in fig. 5, where a man in attendance examines it, after which the apron, actuated by the lever shewn in sketch is lowered and the coal allowed to fall gently into the car.

WORKSHOPS.—These consist of a carpenter's blacksmith's, car, machine shops and sawmill. The machine shop contains lathes, drilling and screwing machines, also the dynamo for electric lighting. The sawmill contains travelling rotary saw and cross-cut, drilling, and notching machine for cutting groove in edge-rail sleepers. See fig. 6. This machine will cut and groove 60 sleepers per hour. When formerly cut by hand they were turned out at the rate of 10 per hour per man.

MODE OF WORKING.—The seam is worked on the bord and pillar system; each lift is 450 ft.; the levels are S.E. and N.W. 20 degrees; the dip is 20 degrees on the north and 16 degrees on the south side; counterbalance planes are driven every 450 to 500 ft.; the bords are 12 ft. wide by 9 ft. high on the south, and 10 ft. wide by 7 ft. 6 in. high on the north side; heads are driven every 50 ft., 6 ft. by 6 ft.; the pillars average 50 ft. by 40 ft.;

the roof is left on and no timber, as a rule, is required until the extraction of the pillars. The main levels of every lift are driven out to the extreme boundary before the work of opening out by bords is commenced. The coal is then worked back towards the slopes. No explosive is used, the coal being worked by maul and wedge.

EMPLOYEES.—The average number of persons employed are—underground cutters 176, loaders 24, on cost 70, hoys 66, total 336; surface 118 men and boys; total underground and surface 454. The average daily output is 900 tons in summer and 500 tons during winter months when working.

SHIPPING WHARF.—This is situated at Granton, on the Middle River, 7 miles north of the mines, with which it is connected by a line of railway owned and operated by the company, Steamers of 2,600 tonnage can and have loaded here. The quantity shipped over this wharf last year was 100,000 tons. Two locomotives and some 160 hopper cars are employed during the shipping season. The total output for the mine for the year 1892 was a little under 200,000 tons.

TUNNEL FIRE.—A tunnel having a rise of 1 in 160, size 10 ft. by 8 ft., started from the 3,200 ft. level and driven against the measures, S.W. 70 degrees, has just been completed, which intersects the second seam at 1,000 ft.; the strata passed through consists wholly of fire-clay and blue shale. The explosive used in the driving of this tunnel was Roburite, manufactured at Halifax by the Canada Explosive Co., fired by the electric battery. No fire damp was seen until strlking the coal by a test bore-hole, about 80 ft. deep; this, however, was not very great, and it was not until the tunnel met the coal that heavy feeders of gas were found. These feeders increased as the seam was opened up, but there being a good ventilation no difficulty was experienced in dealing with the gas and keeping the place clear. Affairs were soon to be changed, for at 6 p.m. on 7th December, 1892, the coal caught fire from a shot. Two shot holes, the on the right, the other on the left, were drilled in the rock. The former was 3 ft. deep and charged with 11 oz. of Roburite, the other 2 ft. 6 in. deep was charged with 8 oz. of the same explosive; both holes were well prepared and tamped and both shots were fired together by the electric battery, which was placed some 185 feet from the face. Simultaneously with the putting in action of the battery a sharp explosion took place, knocking over the men, damaging the ventilating troughs, and putting out all lights. The men after getting out to the main slopes, and procuring fresh lights, returned to the tunnel and endeavored to extinguish the fire, but without avail. The writer was then sent for, and immediately proceeded to the seat of fire, where he was shortly afterwards joined by his deputies and many willing volunteers. The fire by this time had made considerable headway, and the "damp" was back some 90 ft. from the face, beyond which point no lamp would burn. The mine pump was brought into requisition and water conveyed by a 3 in. hose to the fire. The hose, however, would not stand the pressure, and wrought iron tubing was restored to, which fortunately was already laid in the tunnel, and carried to within 100 feet of the face, when the hose was attached. This gave a good supply of water; the flames were after some hours work beaten down, and the fire was believed to be under control, when the nozzle of the hose got stopped up. This having to be taken off and put right, some fifteen minutes cessation of work took place, everything at this point having to be done in the dark as no lamps would burn in the damp. This stoppage proved very disastrous, for no sooner was the hose got to work again than the flames burst out afresh, setting fire to the gas, which had accumulated in the meantime, and causing a second explosion, which acted similar to the first. With the exception of a couple burnt and one slightly hurt, all escaped without injury. An examination of the tunnel afterwards showed that the "damp" was some 300 feet back from the face and that the fire was increasing. The writer then decided to build a dam across the tunnel and flood it. This was commenced at a point 385 feet from the face, not, however, before a third explosion took place, though slighter than the preceeding ones. This could not be built up as high as desired in consequence of the damp becoming so strong that men could not work at it. To make doubly sure of extinguishing the fire, and at the same time hermetically sealing the tunnel, a second dam was built 230 feet back from the first and high enough to flood the tunnel to the roof for a considerable distance inside and this proved effectual. The water was allowed to remain in for about ten days, when it was drawn off and the work of opening up proceeded with. This had to be prosecuted very cautiously as a very large volume of fire damp was present, at one time not less than 25,000 cubic feet. After some two weeks work the place was cleaned up, repaired, and the face reached, where it was found a fall of a considerable height up had taken place. The metals from this fall were found to be somewhat warm and caused some uneasiness at first, seeing that so large an amount of fire damp was present. The shale, however, is not bituminous and soon cooled down. No explosive has since been used and some six feet of coal has been bared by mall and wedge. The quantity of gas being given off is very heavy, and it has been decided to let the face stand for a time to allow the gas to drain itself; in the meantime a pair of slants are being driven down from the second seam upper workings, which will meet the tunnel making connection and a good return to the upcast. Since the occurence of the above fire the writer has repeatedly been asked "but is not Roburite flameless?" From his above experience what other reply can he make but no! Not under all conditions. The hole was well prepared and tamped, the charge was fired by electricity and did its work thoroughly, bringing down the rock as desired. That there was both flame and gas present at the same time cannot be denied, but as the writer hopes to have an opportunity of discussing this question at a later date he does not purpose saying anything further on the subject at present more than he has always had the greatest confidence in the explosive, that many thousands of shots have been fired at these mines without showing evidence of flame, and he believes that had the explosive been supplied direct from the works of the Roburite Co., at Gathurst, England, no explosion would have occurred.

The Phosphate Deposits of the Ottawa District.

DR. R. W. ELLS.—The phosphate deposits of the Ottawa Valley may be arranged under two heads, viz: those which belong to rocks of the Laurentian System, and those which occur within sedimentary fossiliferous strata of Cambrian and Cambro-silurian age. Concerning the latter, but little has been said of late years; but in the earlier reports of the Geological Survey, attention was directed by Dr. T. Sterry Hunt to the presence of phosphatic nodules in the sandstone of the Chazy formation at West Hawkesbury opposite Grenville on the Ottawa River and the opinion was expressed, that if the sandstone in which these nodules are thickly distributed were burned and ground a fine manure for stiff clay soils would be produced. Similar nodules occur at several points along the St. Lawrence below Quebec, but do not appear of such economic importance as those found near the Ottawa.

The discovery of Apatite in the Laurentian rocks of Canada was first made and noted in the vicinity of the Lievre by Lieut. Ingall, in 1829, but beyond the mere mention of its presence, little attention was paid to the subject for nearly a quarter of a century. Dr. T. S. Hunt also directed attention to its occurrence in the Laurentian of North Burgess, Ont., in the report of the Geological Survey for 1847, and pointed out its great economic value as a fertilising agent. In 1849-50, the presence of phosphate of lime in the Laurentian rocks of the township of Hull, opposite Ottawa, was noted as well also as at Bay St. Paul and Murray Bay on the north side of the St. Lawrence below Quebec. From the economic standpoint however, these lower St. Lawrence deposits have never been made the subject of much study, owing presumably to the greater importance of those found in the Ottawa Valley.

The mining of Canadian apatite may be said to have commenced in Ontario, about thirty years ago the first direct reference to this being found in the pamphlet prepared for the London Exhibition of 1862, by the Geological Survey of Canada, where a brief notice of the apatite deposits of North Elmsley is given. Mining however progressed but slowly in this section; for although the Brockville chemical works were in operation from 1869, and consumed a considerable amount of the output in the manufacture of super-phosphate, the entire production of apatite from the mines of Ontario from 1863 to 1875 averaged little more than 1000 tons per year. This mining was carried on mostly in the form of open cuttings, the deposits where exposed being worked out in shallow pits or trenches, and deep mining was carried on to a very limited extent, the two deepest shafts reaching to a depth of only one hundred and thirty-four feet, and seventy feet respectively. This was on the tenth lot of the sixth concession of North Burgess. Subsequent to 1876 the output for this district slightly increased the quantity extracted between the year 1878 and 1889 as given in the last report of the Geological Survey, both years inclusive, being about 16,000 tons. For the province of Quebec, the first notice of phosphate mining is found in Vennor's report for the Geological Survey for 1873-74; a few tons being taken out in the vicinity of the Little Rapids on the Lièvre in 1871. The growth of the industry steadily increased and in 1877 the total export of apatite from the mines of the province was nearly 3,000 tons. The discovery and opening up of new deposits in Templeton, Buckingham and Portland raised the output rapidly, till, in 1885, the shipments reached a total of 28,535 tons for the Quebec district alone, which amount, has, owing to various causes apparently not been surpassed since that date.

Much has been written concerning the mode of occurrence and the geological relations of the apatite deposits both of Quebec and Ontario by geologists, mining engineers and experts of Canada, the United States and Great Britain, and a great variety of opinions have been put forth by these writers on this subject. Thus some authors contend that the mineral is of organic origin, and urge in support of this view the presence of the ores of iron, graphite, and the peculiar fossil firm *Eozoon Canadense*, found in certain of the Laurentian limestones and regarded by Sir Wm. Dawson, Dr. Hunt, and Dr. Carpenter as representing the earliest known traee of animal life. By others the view is maintained that the apatite has resulted from the action of a solution, bearing fluorine and phosphorus, in what combination it is impossible to say, upon a bed of limestone; and that this solution traversed the main mass and was distributed by means of side fissures, the result of which upon the limestone of the bed, was to convert a portion into fluor-apatite.

By others again the opinion has been stated that the mineral has been "derived principally from the pyroxenite, in which it is generally found, that the pyroxenite itself is probably derived from igneous sources, either as submarine injections while the Laurentian rocks were being formed or as subsequent intrusions, even though presenting much of the aspect of bedded rock."

In Norway, Messrs. Broegger and Reusch have also maintained the eruptive origin of the apatite found in that country in rocks apparently of the same geological horizon as those which contain the mineral in Canada, and the same view as regards the Canadian apatite in the district north of Kingston, Ont., is expressed by Mr. Eugene Coste in the report to the Geological Survey for the year 1887-88. Dr. Selwyn, in a note in Report Progress for 1888-89, p. 93 k., also says "there is absolutely no evidence whatever of the organic origin of apatite, or that the deposits have resulted from ordinary mechanical sedimentation processes; they are clearly connected, for the most part, with the basic eruptions of Archæan date."

The early views as to the structure of the Laurentian rocks regarded them as in great part, made up of altered sedimentary strata. These were found to be penetrated by dykes of trappean and dioritic matter and by masses of syenite, while the areas of pyroxenic rocks and quartz-feldspars which occur at various points were regarded as regularly interbedded portions of a stratified series of gneiss and limestone. Certain areas of anorthositic rocks, often of large extent which occur in connection with the Laurentian, north of Montreal, were regarded as forming the upper member of the Laurentian system and it was supposed that there was a gradual passage downward from this rock into the gneissic portion. The recent work on these rocks, principally by Dr. Adams, now of McGill College, but for some years attached to the staff of the Geological Survey of Canada, has shewn that they are intrusive and more recent than the gneiss and limestone with which they are in contact, since the anorthosite, while some times occurring along the banding of the gneiss, frequently cuts across the strike of both abruptly, and has also produced a manifest alteration of the strata at the lime of junction of the two series; in the same way much of the pyroxenic and quartz-feldspar rocks extend in lenticular masses along the planes of stratification of both the limestone and gneiss, and this mode of occurrence has presumably led to the supposition on the part of the earlier observers in this field, that these rocks were also to be considered as integral portions of the altered sedimentary formation of the Laurentian.

But while many of the pyroxenic and quartz-feldspar rocks do assume the aspect of bedded dykes, in other places these rocks unmistakably cut directly across the stratification of the gneiss and associated strata and penetrate the containing beds at all angles after the fashion of true dioritic dykes, and thus they furnish quite conclusive evidence of their igneous and intrusive character. But further at a number of points dykes of pyroxene are intersected by subsequent dykes of quartz-feldspar rock, while both these in turn are cut by more recent intrusions of fine grained and dark trappean rock.

The apatite has been decribed generally as occurring either in the form of beds, by some, or as veins by others, while yet other authors assert that certain of the deposits are in form of beds, and other portions are of the nature of veins. By far the greater part, however, of the statements made on the subject tend to show that, in the opinion of the writers, the deposits occur mostly in direct association with stratified gneiss and limestone, the pyroxenic rocks being regarded as a portion of the gneissformation, while their connection with intrusive igneous rocks is for the most part ignored. They are stated to occur in two ways, viz., in connnection with the pyroxenic gneisses or in the crystalline limestone, either in the form of veins or scattered crystals.

In the paper published by Dr. Penrose in 1888, "On the nature and origin of deposits of phosphate of lime," a chapter is devoted to Canadian apatites, which is the result of a somewhat prolonged study of these deposits as they occur in Ontario and Quebec. As to the distribution of the apatite Dr. Penrose remarks that "the mineral occurs almost without exception in association with pyroxenic and horn blende rocks. This rule especially holds true in the Quebec district, where the phosphate has never yet been found without being associated with pyroxene rocks, possibly often of vein origin." He further states that "the pyroxene rock is never found distinctly bedded, though occasionally a series of parallel lines can be traced through it, which while possibly the remains of stratification are probably often joint planes, and sometimes when the pyroxene has been weathered, apparent signs of bedding are brought out, which are often parallel with the bedding of the country rock." And again he says "the gneiss in some places has no distinct line of separation from the pyroxene, but seems to have been impregnated with some of it, forming for a few feet from the line of contact, a more or less pyroxenic gneiss, which is easily decayed and eroded by weathering."

In the report of the Geological Survey for 1863-66, Dr. Hunt discusses the occurrence of apatite in the North Burgess district, and states a number of facts, from which we learn that the mineral occurs there in two ways, viz., first in association with pyroxene, regarded at that time as a form of gneiss belonging to the sedimentary series, in which case it is generally massive; and second, in the form of crystals, often of large size, disseminated through limestone. In this case the deposit frequently takes the form of veins, the associated minerals being pyroxene, mica, sphene, etc. The close relationship of the apatite with the pyroxenic rock is however clearly pointed out and the statement is made that "although not met with in orthoclase gneiss, the presence of apatite seems characteristic of the interstratified pyroxenic rocks of this section, in which it is generally found in small grains and masses, alike in the granular and the micaceous schistose varieties." A number of cases are cited where the mingling of apatite with pyroxene is readily seen, as well as of the association of the apatite with the limestone, in which case also there

is a clear relationship apparent between the two, the pyroxene occurring in the form of dykes or veins which cut the limestone transversely to their strike and in which there is very frequently a mingling of apatite and pyroxene crystals.

In cases where the apatite occurs in the limestone, both in Ontario and Quebec, the crystalline form is the predominent one. Some of these crystals are of very large size, weighing several hundreds of pounds, which are sometimes sufficiently numerous to warrant the investment of capital for their extraction. This form of deposit, however, appears to be more frequent in Ontario than in Quebec, though in the latter province several such mining areas have been worked, more particularly in the country directly east of the Gatineau.

In a report on the North Burgess district by Mr. Vennor to the Geological Survey in 1873-74, a description of a great number of openings is given, from which it is easily seen that the principal deposits in that section occur in connection with the pyroxene bands and he states that, though many openings have been made in the crystalline limestone, the mineral in these cases almost invariably assumes the form of crystals, which, when sufficiently numerous, are of economic importance, but which generally do not compare in value with those in the pyroxene rocks.

In the same report also a brief description is given, for the first time, of the phosphatc deposits of the Buckingham area, in which he states that the apatite occurs there in a pyroxenic rock, with which is associated a good deal of orthoclase gneiss; and so strong is the resemblance in some portions of the district between the apatite and the containing rock that some hundreds of tons of the pyroxene were mined by one company under the impression that the rock was phosphate.

The Laurentian rocks of Ontario and Quebec, in addition to the series of limestones and gneisses which make up the bulk of the system, contain also great masses, regarded by most persons who have studied the subject in recent years as of igneous origin, which have been intruded into the mass of the stratified deposits. These intrusive rocks are supposed to represent portions of the original magma or crust of the earth. Among these are great areas of anorthosite already briefly alluded to, in which the prevailing feldspar is of the variety known as labradorite, together with great masses of syenite and granite, diorite, trap, porphyry, pyroxenic and quartz-feldspar rocks. The intrusive character of most of these is seen in their action upon the strata which they penetrate, and in the cutting off or distortion of the mass in contact, or by the generation of crystals of various kinds in the gneiss or limestone or sometimes in the mass of the dyke itself. Some of these intrusions have exercised but little apparent influence upon the occurrence of economic minerals, but in the case of others, notably the dykes of pyroxene and quartz-feldspar, such influence is very marked.

The gneissic portion of the system comprises rocks of various kinds, certain portions being largely quartzose, while others are almost devoid of quartz. Certain bands are black and hornblendic while others are red from the prevalence of red orthoclase feldspar. Other bands again are highly garnentiferous while at times scales of graphite are so thickly disseminated as to make their extraction and purification a matter of economic importance. In certain areas, bands of limestone, generally of some shade of white or grey, are found and these are occasionally greenish from the presence of serpentine, in which case not unfrequently small veins of asbestus or rather chrysotile occur, which in several localities have been worked to a limited extent.

Over large areas the series as a whole frequently present a well banded or stratified arrangement as if resulting from the alteration of sedimentary deposits. In the areas now regarded as intrusive, while stratification does not appear, a certain foliation is manifest, not only in the syenites and anorthosites but in certain portions of the pyroxenite areas, which structure is however very probably due to pressure during the great period of crumpling to which these rocks have been subjected.

At different points throughout the district north of the Ottawa, more particularly in the area celebrated for the deposits of phosphate and mica, the relations of the several masses of the intrusive rock to the surrounding gneiss can be well studied and in order to depict these more clearly a series of photographs were taken for the Geological Survey of Canada during the past season by Mr. H. N. Topley, which have been colored to show the gneiss, the pyroxene and quartz-feldspar and the apatite.

Among mines thus illustrated are the Little Rapids, the London, the North Star, the Villeneuve, Crown Hill and High Rock in the Lièvre district, and the McRae mine in the Township of Templeton.

In the last named mine the pyroxene dyke which carries the apatite cuts directly across the strike of the gneiss, and has been mined out almost entirely for nearly a hundred yards along its course, the sharply defined contact of the edge of the gneissic strata with the mass of the dyke being well exposed. At the Little Rapids mine the pyroxene cuts the stratification of the gneiss at an angle of about thirty degrees, so that in the open cut which is left by the removal of the pyroxene, the edge of the gneiss is also brought into view. At the London mine, the pyroxene for a part of the distance is intruded along the lines of stratification but the contact of the two series of rock is abruptly and clearly defined. At the North Star mine most of the principal openings are in the pyroxene dyke which follows the strike of the gneiss, but at several points in its course the gneiss is thrown out of its regular strike by the agency of the intrusion.

The great dyke at the Villeneuve mica mine consists largely of quartz and feldspar. It has an exposed breadth of about fifty yards and follows closely the stratification of the gneiss, but at several points spurs break into the rock along the contact. At Ross Mountain, Crown Hill and High Rock as well as at the mines to the north in the direction of the High Falls the country gneiss which here forms a series of hills from 500 ft to 700 ft above the River Lièvre is intersected by a series of pyroxenic and quartz-feldspar dykes. Some of these apparently run along the lines of stratification of the gneiss, while others break directly or transversely across the gneissic strata; and at many places the different dykes interlace one another in a wonderful manner. At Crown Hill the great masses of pyroxene have thrown the gneiss entirely out of its normal strike, while several of the pits show a capping of gneiss above the intrusion. A similar feature of the gneiss and pyroxene is seen at the North Star.

That these masses of pyroxene are deep seated is seen at the High Rock and the North Star workings, at which points the openings at the summits of the hills are at least 600 feet above the river at their base, while the lower workings at the North Star have reached a vertical depth of at least that extent and at the High Rock, the most productive ground at present is from the levels lands near the base of the hill at a depth of over 400 feet from the surface workings. In both these mines which are specially cited as showing the greatest depth of workings, the prospect for successful mining in so far as the quantity of phosphate is concerned is no less satisfactory at the bottom than at the top. In fact in view of the intrusive nature of the apatite-bearing rock it would appear that the old contention put forth by some that the workable deposits were superficial in their character must now be set aside, and it may be regarded as reasonably conclusive that the extraction of this mineral in the pyroxene district will be limited only by the state of the market and the increased cost of mining from greater depths. The peculiar interlacing of the several kinds of dykes is well seen at Crown Hill and High Rock where in one of the pits of the former mine, the pyroxene first cuts the gneiss, and is in turn penetrated by a broad dyke of quartz-feldspar, while both are intersected by a four foot dyke of fine grained black trap-rock. Not only is their intrusive character in this way clearly shown but this view is supported by the presence of various zeolites, and other minerals peculiar to igneous rock, and in crystals of sphene, zircon, mica, &c., near the contact with the gneiss.

In the study of the apatite deposits themselves at many points a feature in regard to their occurrence was noted which is worthy of mention. Thus while the mineral is in places disseminated more or less through the mass of the pyroxene dykes it does not appear in connection with those of quartz-feldspar, with which however mica crystals are frequently found, as in the case of the great dyke at Villeneuve. Further it will be seen from the study of the pyroxene dykes themselves that many of these contain little or no apatite whatsoever, and that in the case of the workable deposits, the mineral is almost always in close proximity to the contact with the gneiss, and this is a point of importance to be observed in the search for as well as the working out of these deposits. At High Rock and the mines in the vicinity where the pyroxene dykes are numerous, masses of gneiss, often of limited extent are held in the pyroxene, but the occurrence of the phosphate in close proximity to the gneiss is seen in nearly every one of the many openings in this district. No deposits of any economic importance have been found in the regularly stratified country gneiss at any point though an occasional crystal, sometimes of large size has been found.

At the North Star mine, in the main pit, which has a depth of over 600 feet, two irregular deposits of apatite are seen in the upper workings. These do not show the structure of regular veins, but, while pursuing an irregularly defined course in the walls of the cut, gradually approach each other as they descend. Ramifying branches are given off from either side of the main deposit and the quantity of the apatite increases or diminishes at various points throughout the extent of the opening; the prospects for successful mining being apparently as good at the bottom of the shaft as at the surface. From the series of openings made on this property, it would appear that the apatite follows a somewhat regular course in the pyroxene near the gneiss, but occurs principally in a series of large bunches or chimneys connected with each other by smaller strings or leaders. Sometimes these pockety bunches of ore are of irregular shape, and yield hundreds of tons, but present none of the characteristics of veins, either in the presence of hanging or foot walls, while many of the masses of apatite appear to be completely isolated in the mass of pyroxene, though possibly there may have been a connection through small fissures, with other deposits. The lack of any connection between these massive apatites and the regularly stratified gneiss is evident; and their occurrence in the pyroxene is further evidence in support of the view that these workable deposits are not of organic origin, but confined entirely to igneous rocks.

In certain cases where a supposed true vein structure has been found, such structure can be explained by noticing that the deposits of phosphate occur, for the most part at least, near the line of contact, between the pyroxene and the gneiss. The latter of these, reached in the excavation, has been regarded by the miners as constituting the foot wall, owing largely to the difference in character between it and the rock which carries the apatite, and also to the fact that the occurrence of the mineral ceases when the gneiss is reached. No true hanging wall, in so far as I have been able to study the deposits, has ever been found in connection with the pyroxene-gneiss deposits; but frequently, in the case of dykes of moderate extent, where the gneiss is in contact in both sides of the pyroxene, the apatite is found along both margins of the intrusion. This mode of occurrence also accounts for its continuance along certain regular vein-like lines, since the apatite generally follows closely the course of the dyke.

While as has already been stated igneous and intrusive masses and dykes occur at many places in the Laurentian the area of the pyroxenic apatite bearing rock, is in so far as at present known quite limited; for as in the case of the Eastern Township serpentine, where but a comparatively small portion of the rock is asbestus producing so also much of the pyroxenite is apparently non-productive of phosphate. This uncertainty as to the extent of any particular deposit should be taken into careful consideration when investigating the merits of a supposed phosphate area, and in some cases doubtless a diamond drill could be advantageously employed.

In regard also to other deposits of the economic minerals found in the Laurentian rock, such as graphite, mica, asbestus, and presumably to some extent at least the iron ores the same association of intrusive dykes is observed. Thus in the asbestus mines of Templeton the asbestus bearing serpentine occurs in a narrow band adjacent to a dyke of whitish crystalline dolomitic looking rock, somewhat calcareous but which on examination apparently possesses the structure and properties of a calcareous pyroxenic dyke. In the serpentine near the intrusion, the asbestus occurs mostly in small veins, the fibre varying in length from mere threads to half an inch, though occasionally several of these unite to form a vein of an inch or even sometimes longer. That the serpentinous quality of the limestone, upon which the asbestus depends is due to the action of intrusive rocks would appear from the fact that wherever serpentineous limestone occurs a dyke of diorite, syenite, or quartz-feldspar is in close proximity. So also in the case of the disseminated graphite it is found that near the large deposits or areas of graphitic gneiss, masses of pyroxene or some allied rock occur which have evidently exerted a metamorphic action upon the adjoining strata, while most of the mica deposits occur as crystals either in the mass of the dyke itself, often in this case, a quartz-feldspar or in the gneiss, or limestone near the contact.

From the evidence just presented, regarding the intrusive origin of the pyroxene or apatite-bearing rocks, the question of the formation of these mineral deposits may be briefly discussed. From many analyses, we know that all pyroxenes contain a very considerable amount of calcite, ranging from twenty to nearly thirty per cent. Since, then, the pyroxene in its intrusion with the gneiss must have ascended along lines of fracture or least resistance, it would appear reasonable to infer that vapors charged with phosphoric acid, ascended along such lines, rather than through the mass of the dyke, and that in certain portions in proximity to the margins of the dyke, these vapors impregnated the softened or heated mass, from which, as a result of chemical action upon the calcareous portion, the phosphate of lime was produced. The mineral would, therefore, appear to owe its origin to chemical agency, rather than to organic.

It being six o'clock the meeting adjourned.

Evening Session.

On re-assembling Capt. Adams called upon Mr. J. McEvoy of the Geological Survey of Canada, Ottawa, for his paper entitled:—

Notes on Hydraulic Mining in British Columbia.

MR. JAS. McEVOY.—In the first efforts of the pioneer gold seekers, the gold was extracted from the gravel simply by the use of the pick, shovel and gold pan or rocker. Sometimes a sluice box was added and the "pay dirt" shoveled into it was washed by a stream of water, the heavier materials such as gold and platinum sinking to the bottom were caught and held by the riffles or cross-bars, there placed for that purpose.

This method of course was only applicable to the shallow diggings, and as the greater part of the diggings especially the richer part were deep, operations had to be conducted on a large scale. Accordingly shafts were sunk and tunnels driven to "bed-rock" and the richer gravel was carried to the surface and there washed in a sluice box in the ordinary way. In some cases the material was raised by hand power, but in the larger works steam or water power, (generally the latter) was used. Where tunnels could not be driven to drain the mine, such power was essential to remove the water. The degree of excellence obtained by the miners in manufacturing the machinery for the application of water power, is a matter of suprise, considering the crude nature of the material of which it had to be constructed.

After this manner all the paying creeks discovered were worked, and at the time, by many, they were thought to be worked out; experience showed however, that although most of the gold was confined to the lower gravel a considerable amount was distribued throughout the entire deposit of the creeks. A short statement of the manner in which the placer gold was deposited will explain this.

During the period of erosion, before the glacial period when the creek beds were worn down to the form in which the bed rock lies at present, the particles of gold set free by the grinding action of the boulders, collected

in the bottom and were not carried far on account of their weight. Sometimes during this period the course of a stream became diverted to a new direction in which it continued to run, thus leaving an older and a higher channel to one side. The existence of such channels is often a matter of speculation to the miner and the solving of such a question is one of the ways in which a geologist can be of practical assistance. The power which caused this erosion gradually lessens in force and the channel begins to block up and is slowly filled to the height of the terraces now found lining the sides of the valleys. During this second period particles of gold are still being carried downward and are necessarily scattered more or less throughout the deposit. A third or last period is marked by the water again cutting a channel through the deposits of the second period and in a natural way separating the gold therein contained and collecting it at the bottom of the present channel.

The quantity of gold deposited during the second period mentioned is not sufficient to pay the miner operating in any of the ways already mentioned. To separate this gold the Hydraulic system is used which at the same time collects all that was missed by the comparatively incomplete methods previously employed.

All the claims on a creek or part of creek suitable for working by this method are amalgamated and beginning at the bottom the whole creek is washed out. A stream of water brought from wherever attainable, often from a great distance, is under a head of one to two hundred feet directed against the gravel bank which slowly melts under its force. The mouth piece called a "Monitor" is so constructed with a universal joint and counter-balanced as to be easily operated by one man and pointed in any direction. Such a stream is very effective against a gravel bank, large rocks and embedded tree trunks being quickly dislodged. All the water flows off through a flume carrying with it the smaller material and boulders up to 4 or 5 inches in diameter. The larger boulders are removed and piled up on one side. The flume is constructed of boards and is water-tight with the bottom paved with sawn blocks to withstand the great wear and tear of the flowing gravel.

The most difficult problem to be contended with is the disposal of the tailings where the grade of the creek below the place of operation is low, when the flume has to be carried a great distance to a suitable dumping ground. Unless there is a sufficient supply of water the material frequently blocks up in the flume thus necessitating watchmen to keep it clear. Sometimes it is found practicable to bring an additional stream of water into the flume some distance below the place of operation which ensures a safe transfer of all tailings from that point downward.

The gold is caught in the same manner as in the ordidary sluice box by riffles. Where very fine gold exists blankets are placed in the bottom of the flume or sometimes amalgamated plates or mercury. These riffles should be placed at a sufficient distance from the commencement of the flume to allow the gravel to be well washed so that the particles of gold may be well polished before coming in contact with the amalgamated plates. There is no doubt that some fine particles still escape but it is safe to say thatthis method by far exceeds others in its closer approximation to a complete extraction of the gold.

Many localites in Cariboo have been extensively worked in this manner for years notably Stout's Gulch, Conklin Gulch, Grouse Creek, the hill sides of William's Creek, North Fork of Quesnel River, etc., etc. Many still remain untouched by the Hydraulic System, some have never been "bottomed" even by shaft; notably Slough Creek. All the tributaries of the upper part of this creek paid well, but the presence of "slum" or soft mud in the bottom of the creek prevents the miners reaching the bottom as the mud oozes upward filling the shaft as quickly as it is removed. A company is now beginning operations on this creek with very good prospects of success.

Charters have been issued to work several of the larger creeks by the Hydraulic system or otherwise, but as the grade is generally very low and the bed rock deep, a great expenditure of capital is required before any paying results can be obtained, however; there is little doubt of a rich harvest eventually rewarding the undertakers.

Several machines have been invented for working gravel deposits. Their object being to overcome the difficulty of removing the tailings, and to dispense with the necessity of a large supply of water. Once these machines are in operation, less than ten miner's inches of water suffices.

The tailings are carried up an elevator and piled to one side, drainage thus being only required to remove the water.

During the last few years the Hydraulic system has been applied to the low terraces and river flats along the Fraser river. The gold here is generally confined to one layer of gravel, but the covering is too deep to allow of it being profitably removed by hand. In operating this sort or ground, care should be taken to secure the shortest transfer for the tailings to a dumping ground. This is generally accomplished by working from the river front backward at right angles, across the claim.

Before closing it would be well to pause long enough to consider the ultimate profit or otherwise of such enterprises. As far as the creeks of Cariboo are concerned there is an undoubted benefit with no after bad results but when the terraces of the Fraser river come under consideration, it is not so easy to say so. Unquestionably it is profitable to the owners and also to the country in proportion to the amount of money spent in wages and for supplies. On the other hand if the terraces soworked were suitable for agricultural purposes there is a permanent yearly loss for ever afterward, even if such land required irrigation for where water can be had for hydraulicing it can also be obtained for irrigating purposes. The land worked over by this process is rendered for ever useless as it is covered with bare boulders to a depth of 3 or 4 feet and over. Sometimes in addition to this land being destroyed the tailings instead of being dumped into the river are scattered over other lower terraces or flats thus doubling the damage. This question was for years a matter of litigation in California and was eventually decided against the miners. All such operations being prohibited in future.

DR. RAYMOND—The closing sentence of Mr. McEvoy's paper seems to call upon some of us from the other side of the line to speak; and, as I was United States Commissioner of Mining for a good many years, and have some knowledge of the history of mining in the State of California with regard to the effect of the tailings upon the land, and also the effect of the subsequent action of the land owners upon the owners of the tailings, I will ask the priveilege of being allowed to say a word or two.

In the first place, whatever may have been the wisdom on other grounds of the legislation which took place in California—the litigation and legislation by which hydraulic gold mines of that State have been shut up for a good many years—nobody can deny the unfortunate effect of that legislation in an economic way upon the interests of California. For it had come to pass that just at that time what is known as the silver question had produced, not only in the United States, but in all civilized communities, owing to the relationship of exchange, a very great deal of perplexity and trouble, and the stoppage of hydraulic mines in California just at the time when they would have become and continued until now to be a source of large annual production of gold, aggravated a trouble which was due on the other hand to a very extraordinary increase of silver. By our double action in the States, on the one side by shutting up 10,000,000 of gold per annum, and on the other side by a sort of legislation in regard to silver ores, which stimulated the production of such ores outside the States, and which has in that way established in Mexico, largely with American capital, a capacity only second to that of the United States, we have halved our productiou of gold; and on the other hand doubled our production of silver. Thus we have in both directions done the utmost we could to aggravate much of the trouble which has afflicted the countries of the world.

Now, as to the wisdom of that legislation in California, taking another standpolnt altogether; namely, the standpoint which I have no doubt Mr. McEvoy takes, the interest of the future and permanent value of land. Perhaps I am a little prejudiced against the grangers, but I think that, the question, and the answer to it, depend very largely upon another question, namely how much land are your tailings really spoiling, and what is the land worth now, and how much is there left, after you have spoiled it, for the ordinary uses of mankind? In other words, how much land can you give up to the industry of mining gold? We give up land to other industries. We do not insist that persons who have absorbed land by putting brick buildings on it have thereby necessarily injured humanity. Therefore, it is a comparative question; though I grant freely it is a serious matter to hurt agriculture. But the natural law makes agriculture, even if the so-called agriculturist has come and settled in the neighborhood after the nuisance; as was the case in California. We went to California and found gold; and we developed the country which never would have been thought of but for the gold. We began to dig gold, and the grangers who came to settle in the villages and afterwards sued us for damages, came there on purpose to be injured. They were like the virgins in Don Juau, who, Byron tells us, stood around waiting for the ravishing to begin. They—the grangers—could not make anything in farming, but they came there; and that to some extent was the nature of the persecution in California; which ended in shutting up all hydraulic mines. The pretence about the "navigable" rivers I think none of us need discuss. Those of us who have seen the St. Joachim and Sacramento Rivers will agree I think, that the sooner they are made unnavigable the better.

It is a very curious fact all over the world that agriculture fills up the rivers more than mining. As a matter of fact, in some cases in California, we went down to the beds of the rivers and found the nuisance there. It came from the plow of the granger, who, having broken up the surface of the ground, had made it easy for the rains to wash it into the rivers. But that mere injury to navigation was not, after all, everything. It would be dishonest to deny that the serious matter was the covering of arable ground with sandy deposits of tailings which certainly was not arable; and of course, if we had covered it several feet with boulders we would have made the matter still worse. But I take the freedom of saying that I do not think the amount of land injured in hydraulic work by being bared in that way would be a very serious matter. A much more serious matter is the actual disposition of the tailings; and that is an evil on the face of it that goes on for years and years. You may be careful with your tailings. You may build up in the last 30 years strong timber dams, and you pile them up and keep them out of the way. But by and by when you are gone, and the property passes into the hands of another company, and they do not want to repair merely ancient dams; and presently some extraordinary freshet comes along, and then the tailings of a generation go down and spoil a county; and it is a very serious matter, and no light matter to settle where the line should be drawn. These things, I think, settle themselves better then we can settle them by legislation or principles. The case in California is settling itself to-day. Both parties are acting in great harmony, in trying to make the sand pay the expense by putting in dams which will impound the tailings safely that will probably pass by.

There is another fact, namely, that farming people do not find it any use for them to have arable land, and have nobody to eat the products. They have been ruined quite as much as any of us. I have been in county after county in which the closing of the mines has ruined the farmers. This is particularly so in California, as the farmers do not raise great things as in the East, like wheat, but go in for the cultivation of vegetables and garden truck, &c., for sale in the settlements. No customers anywhere in the world are as good as the miners. They will pay almost any price. And so their market is the best market in the West. But there are a great many instances in which the land to be destroyed is not worth enough to worry about. There is a great deal of land yet left on mother earth; and we can spare some for towns and some for universities and some—for hydraulic mining.

MR. MCEVOY—I might say that in British Columbia the situation is peculiar as the amount of agricultural land is small compared with that of California.

In Cariboo we set an example which I think the Americans might follow; as the Government agent there undertakes to extend the bulkheads from time to time to keep the tailings back, as necessity requires.

CAPT. ADAMS—Does Mr. McEvoy know the smallest average yield of gold to the yard from the gravel that can be profitably worked by hydraulic processes?

MR. MCEVOY—Some few cents per yard. I do not remember the exact figures.

DR. RAYMOND—Our average actual hydraulic yield in California runs from 15 to 18 cents in the cubic yard. We think we could handle it at 3 cents. That would not include the cost for the tailings, and bringing water to the proper head. Our hydraulic fields in California are generally surrounded by rock. A great deal of the money has been spent there in rock tunnelling. That costs money, and takes a great deal of time; and many miles of these rock tunnels had not got fairly to work to show what they could do, when the courts shut up the business.

MR. MCEVOY—I do not know of any instance of that sort of mining in British Columbia. I quite admit the force of the argument of the necessity of sacrificing to some extent the future for the development of the present. But I would like to ask if the agricultural products of California do not to-day far exceed the mining products.

DR. RAYMOND—I will say very frankly that the agricultural products of California so far exceed the mining products that they could easily afford to submit to a loss of a certain percentage of the agricultural products for the sake of the mining products. The point is really not that the agricultural products of California are not going to be destroyed or wiped out by the resumptionof the hydraulic mining industry, but how much can be given up to mining.

MR. MCEVOY—All lands are the national heritage of mankind and no owner of land has a right to destroy it for any purpose and render it useless to his successors. Agricultural land will go on producing food, which is of a positive value to mankind, while gold is, of itself, no value.

Apatite Mining in Quebec.

MR. J. BURLEY SMITH (Glen Almond, Que.)—The greater proportion of Apatite mined in Canada has been raised in the Ottawa district of Quebec, and as the geological phenomena of occurrence will no doubt be exhaustively treated by Dr. Ells in his paper at this meeting on the Apatite depostts of the Ottawa district, I propose in that portion of the subject I have taken up to confine myself as much as possible to the commercial and industrial aspect of Apatite mining, describing as briefly as possible the economic value and use of this important mineral and the prospects of the industry generally, especially as affecting the locality in question. The practical questions of searching for, mining and winning the mineral and its preparation for market encroaching on the geological features only where it becomes really necessary to illustrate any point connected with the winning of the ore from the rocks in which it occurs.

To those who may be quite unacquainted with the subject I may state that Apatite is the name of one of the various forms in which phosphate of lime occurs.

It is found in many parts of the world, but no where equal in richness and purity to that variety discovered more than 30 years ago and worked up to the present day in Canada.

The Chemical composition of Apatite is theoretically phosphate of lime 91 to 92, chloride of calcium 0·0 to 0·42, and fluoride of calcium 4·6 to 7·7. It has a specific gravity of 3·16 to 3·25 or about three and a quarter times as heavy as water and its hardness is=5 to 6.

In appearance it is an exceedingly beautiful mineral, semi-transparent and the Canadian varieties are generally of a bright sea green, red, brown, grey and blueish according to the admixture of various subtances which enter into its composition.

Its chief economic value is for the phosphoric acid obtained from it and its chief use is in the manufacture of superphosphate fertilizers or plant food used in agriculture to restore to exhausted soils those elements of fertility taken from it by continual croppings.

In the year 1669 Brandt, of Hamburg, discovered phosphorus to be one of the simple elements and in 1769 Scheele discoverad its presence in the bones of men and animals.

It is present in considerable proportion in plants and the agricultural chemist of to-day is able to state the exact amount found in the various roots and plants which go to make up the food supply of the world.

Phosphorous in the shape of phosphoric acid is therefore an important factor in the economy of plant and animal life.

It is absorbed as food by the roots of plants of which it forms one of the principal inorganic constituents. The plants become the food of the animal kingdom where it chiefly enters into the formation of bone and tissue and is again in the natural order of things restored to the soil as an original element of its fertility insuring a constant reproduction.

But in the artificial state of things now existing, with a dense population closely packed on small areas and far distant from the source of its food supply, these elements are not restored to the soil but are from sanitary reasons chiefly allowed to run to waste with no better result than the pollution of our rivers and streams.

Monsieur Grandeau estimated some time ago that one year's crop in France represents 298,200 tons of phosphoric acid of which only 151,200 tons of phosphoric acid were recoverable in the stable dung, thus leaving a deficit of 147,000 tons of phosphoric acid, equal to over one million tons of superphosphate, to be made good by other means.

He also estimated that the entire number of farm animals in France in 1882, representing a live weight of 6,240,430 tons, had accumulated from their food 193,453 tons of mineral matter containing 76,820 tons of phosphoric acid.

When it is considered that this condition of things is going on in all the densely populated countries of the world, and how much phosphorous must be extracted from the soil every year to make the bones and tissues of animal life, it will be seen how necessary it is that at least as much phosphorus should be returned to the soil as is taken out of it, otherwise it will become utterly worn out and unproductive.

In the early efforts to make up the deficit, bones were used on account of the large amount of phosphoric acid contained, and were indeed the first source of supply for the manufacture of artificial manures.

From the respect we all have for the memories of our deceased friends and our desire that their bones should rest in peace, we can feelingly realize that this source of supply is inadequate to meet the deficit.

Professor Liebig once wrote the following warning: "England is robbing all other countries of the conditions of their fertility; already, in her eagerness for bones, she has turned up the battlefields of Leipsic, of Waterloo and the Crimea; already from the catacombs of Sicily she has carried away the skeletons of many successive generations. Annually she removes from the shores of other countries to her own the manurial equivalent of three millions and a half of men; whom she takes from us the means of supporting, and squanders down her sewers to the sea. Like a vampire she hangs upon the neck of Europe, nay of the world, and sucks the heart blood from nations without a thought of justice towards them, without a shadow of lasting advantage for herself."

Notwithstanding this touching lament it was Prof. Liebig himself who first suggested the treatment of bones with sulphuric acid and thus started the scientific manufacture of artificial manures in Europe.

It is stated that as early as 1822 England imported over 30,000 tons of bones from Germany, and it is known that in recent years she has imported from various sources as much as from 70,000 to 100,000 tons a year.

There are of course many other sources of supply of phosphoric acid for agricultural uses, the most important of which has been guano. Since its discovery fifty years ago, as much as 400,000 tons has been shipped annually.

But it can easily be recognized that these sources of supply will rapidly become exhausted.

Basic slag is also largely used as a phosphatic manure in Germany, 30,000 tons having been used in one year.

None of these sources, however, are likely to supply the ever increasing demand for phosphatic manures, and it is to the practically inexhaustible deposits of mineral phosphates that agriculturists are to look for their permanent supply.

Fortunately for agriculture, though perhaps not so fortunately for the Canadian phosphate industry, mineral phosphates are found almost everywhere and frequently in enormous quantities.

The constantly increasing demand for super-phosphates has not had the prosperous influence on the Canadian Apatite industry which might at first sight have been expected.

If Canada was the only place where the mineral existed undoubtedly both owner of mineral lands and the capitalist adventurers would have had very fine times indeed. It is however, found in its different varieties in many parts of the world, and the increasing demand naturally led to more energetic search and exploitation, with the result of excess of supply over demand and the phosphate market has been flooded. The reckless speculation in some countries and the keen competition to raise large quantities of ore regardless of cost, not merely to supply the demand, but to boom the mineral lands for sale has unsettled the market altogether. Prices have gone down enormously, partly because of excess of production, but chiefly, I think, because the manufacturers do not know to what extent this excess may reach, and whether it may not for many years exceed the regular demand in spite of the enormously increased use of superphosphate which is certain to follow in new countries and old, as the new land of the former becomes as impoverished as the latter, and the agriculturists of both become more scientific from sheer necessity.

It cannot be denied that there is at the present time a most serious crisis in the Apatite industry of Canada. In spite of the enormous increase in the supply of mineral phosphates from all parts of the known world, the Canadian Apatite has continued to hold its own up till now, partly because of the extreme purity and richness of the ore, and partly because the output is comparatively small. The shipments of Canadian phosphate have not exceeded an average of 20,000 tons annually, during the last ten years, whilst other countries have figured up to hundreds of thousands of tons, and there has been little difficulty in placing her small output at remunerative prices while they were high, but now she stands face to face with keen competition and very low prices.

From the high character of the mineral it is considered a valuable material in the manufacture of superphosphate, it yields a higher percentage of phosphoric acid soluble in water than any other raw phosphate material. It is much easier to grind than any other variety of mineral phosphate.

The mineral is practically inexhaustible in quantity, and the recent evidence of Dr. Ells, Mr. Eugene Coste, Mr. Ingall and other scientific geologists goes far to show that the present shallow surface pits and even the deepest one of 600 ft. (at North Star mines) are but mere burrowings compared to the almost limitless depths in which these rich deposits may be lurking, and who can define their magnitude and purity under these conditions. But it is difficult and costly under any circumstances to mine, and it is only by patient scientific and systematic working, that these mines can be profitably carried on in the future.

It depends therefore, in a great measure upon the present attitude of the owners of mining land and the capitalists who have already invested large sums of money in the exploitation, whether the industry is to die out or become one of vast importance.

Prices are very low now and I do not see any prospect of a permanent rise for some years to come and we may be quite sure that the old high prices are not ever likely to occur again.

The characteristics of the deposits of phosphate of lime of other countries and the methods applicable to working them go at the same time to show that prices are not likely to be any lower than at present and what we miners have to do now is to try and "cut our coat according to our cloth," and see if by better and more economical methods of working we cannot mine and ship phosphate to meet the present prices.

High prices for both high and low grade ores have resulted in careless hand to mouth ways of mining.

The ore from its bright and attractive appearance and its beautiful crystals and color so distinctly in contrast to the rocks in which it occurs was easily discoverable. It was indeed found by accident and was known to lumbermen and backwoodsmen by sight long before its value as a commercial commodity became known. A demand sprang up for it and the farmers and settlers commenced to dig and quarry it from the surface "shows," as they are locally called.

The vast volume of rock known by the name of the Laurentian formation in which the Apatite occurs runs from north-west to south-east through the Provinces of Ontario and Quebec, and is characterized by the bold outline of its synclinal troughs and anticlinal ridges and it is when the ridges of gneiss, with its overlying limestone come to the surface that the Apatite deposits have been principally discovered and worked.

The Apatite "shows" are sometimes found as superficial deposits in hollows of the rock, oftentimes covering large areas showing something of the appearance of beds but being mixed with the partially decomposed portions of the rocks in which the phosphate is found and being more especially degraded by the decomposition of the pyrites, which is one of the most objectionable features these bonanzas are not always so valuable as would at first sight appear from their accessibility.

They have on the contrary but too often led to the squandering of vast sums of money in the indiscriminate digging of useless holes all over the property in the search for similar deposits, rarely with success, without serving as a guide in any way as to the true method of occurrence.

Local prospectors have been employed by speculators to uncover and lay bare to the sight these attractive shows, maps have been made by irresponsible experts and illuminated with dubs and splashes of emerald green or red covering acres of ground, regardless of scale.

The very name of Apatite has been used to account for the apparent want of order and system.

Even practical miners and experienced mining engineers have been misled by the indisputable fact of having placed before their very eyes large uncovered surfaces of the mineral, often mere crusts of a few inches thick. No one can walk over the estates of some of the mines now properly developed without observing what large sums of money have been spent in sinking holes which have yielded nothing and proved nothing.

The earnest attention of scientific geologists has however recently been attracted to the subject and the result of their patient investigation proves that the occurrence of Apatite is systematic and orderly like all things in nature and will be of immense advantage to miners in the future by showing how the mineral lies and how it should be sought for. Occasionally these surface "shows" have led down immediately to large pockets or bunches of very high grade ore from which many thousands of tons have been raised but this is exceptional and the miner who follows this plan is only too likely to sink a great number of dead holes.

They are, however, clearly the indication of leads or deposits in the neighborhood and if rightly followed up in logical sequence in prospecting the intelligent miner will be able to accurately locate the position and direction of the pyroxene dykes in which the real and permanent deposits occur.

Sometimes the shows appear on the surface like the outcrops of true but irregular fissure veins, having clearly defined hanging and footwalls, and have been followed down to a considerable depth showing also a more or less regular continuity of direction.

Again they are found in bunches like pipe or pot veins.

But in whatever variety, except the surface bed shows, in which case the Apatite is mixed with fragments of gneiss, pyroxene pink calcite, feldspar etc., very frequently containing a number of apatite and pyroxene crystals and earthy impurities forming a debris, which is evidently the result of decomposition or weathering of the exposed portions of the upturned edges of the rocks which has most likely been washed or rolled away in the course of time from their original locality, they are always found at or near the point of contact of the pyroxene with the gneiss.

Whatever may have been the origin of the Apatite and how it came there there is no question that the ore is found only in and accompanying the pyroxene which according to the opinion of the best authorities are immense dykes intruding through the stratified gneiss to the surface not always, however, coming quite to the surface but sometimes covered with a cap rock.

Experience shows that it is useless to look for Apetite away from these conditions.

The deposits having the appearance and many marked characteristics of pockety, veins cannot be called true fissure veins but having these characteristics they can and should be sought and mined for on a system applicable to vein mining. They have often walls corresponding to the foot and hanging walls of true fissure veins. Their direction is not uniform but generally N.E. S.W. varying some degrees, but a group of these deposits appear to always run parrallel to the same axis, having also the same inclination and though the so-called veins may alternate from wide bunches to tiny thin strings they never quite give out and may sometimes be traced for a very long distance.

Again they are traversed by dykes of evidently much more recent intrusion than the pyroxene dykes cutting right up through them to the surface where they present the appearance of hogsbacks. At these points the vein like deposits are thrown to one side or the other forming, as it were cross courses, often widening out at the junction into considerable pockets. Perhaps the strongest feature is that the so-called vein will often continue to follow the face of the cross dyke for a considerable distance laterally and frequently right up to the surface. I am quite unable to account for this unless it has been by the refusion caused by the igneous effect of the last intrusion. The great number of apatite and pyroxene crystals near the surface strongly favouring this view together with the burnt appearance of the rocks at the surface.

In following the lead it is not "struck out" or lost but continues on the other side of the dyke under the same conditions though thrown to right or left as the case may be.

At or near the junction at the surface irregular pockets of considerable size are often found in the burnt rock, containing ore of very high grade though often discoloured and degraded by admixture with the decomposed pyrites, etc.

In some cases as in the celebrated Emerald mine on the River Du Lievre, and the Squaw Hill mine adjoining, four or five of these so-called veins occur, having all the characteristics I have described. The dyke cuts across on the Emerald property and the leads are thrown but continue again on the other side of the dyke, retaining with singular regularity the distance between them in parallel. On the Emerald side the pocket called the "big Murray pit" occurs, from which thousands of tons of ore have been raised, and on the other side the almost equally celebrated Grant pit occurs, which appears to be on the same lead, allowing for alteration caused by the throw. Owing to the rugged character of the ground on the surface and the dumps surrounding the workings, it might not at first sight be noticeable, but from an actual survey made, both of the surface and the underground workings, these leads are found to be almost parallel running in the same line of direction on both properties, viz.. N.E.-S.W. On the Emerald side of the dyke the veins are five in number, and on the Squaw Hill side four showing that there is still one undiscovered on the latter, although since the survey was made certain indications of the fifth have been found which point to its exact and regular occurrence.

Now from the general appearance of the surface and underground workings of all the mines I have visited in the Ottawa district, the same characteristics are traceable in all, and there is clear evidence to show that if all the mines of Quebec and Ontario, those fully developed and those yet only in the prospecting stage, were properly surveyed and carefully plotted, the result would prove that the uncertainty of the occurrence of Apatite has not been established by the collateral evidence of scientific geologists, but is rather the result of the fragmental and crude experience of isolated prospectors and miners operating over a very large area, forming strange and mythic reasons to account for something they could not not be expected to understand or explain.

Geologists cannot afford to be dogmatic, but the exhaustive reports and essays of these geologists of Canada who have spent so much time in patiently investigating

the subject appear to agree generally in their deductions, at any rate within recent years, and seem to prove conclusively that there is no very great uncertainty in the mode of occurrence of this mineral if properly approached, and that starting from the gathered facts and experience already laid open to him, the explorer may find it easily and with certainty, and mine it with the economy which can only result from knowing definitely how and where to begin and how to work it when found.

The improved geological maps which are sure to be the outcome of these researches will be of the greatest use to Apatite miners in the future as they will show more or less definitely the position and composition of the zone in which they have to work.

The colored photographs of Dr. Ells, showing the position of the pyroxene dykes and the occurrence of the Apatite in them are of the utmost importance to the miner who may at a glance ascertain more than pages of written explanation could give him. On commencing to work a new property the miner should make himself thoroughly acquainted with the rocks in which he has to mine, firstly by reading the results of the investigations of those who have made a study of the matter for years, and by a careful examination of the speciments in the magnificent collection in the museum of the Geological Survey at Ottawa. He should then visit the other mines in operation in his neighborhood and see what has already been done—not necessarily for imitation.

Having made himself thoroughly acquainted with these he should carefully prospect and survey his own ground, making only such preliminary shallow trial pits and costeenings as are necessary to establish the position of his mineral ground which will be found usually to occupy a small area compared to the vast volume of barren rock composing the general area of his property.

The position and run of this can best be ascertained by baring the rocks at or near the occurrence of the pyroxene, in the neighborhood usually of the easily seen surface shows—carefully avoiding undue disturbance of the natural appearance of the surface of the rock by blasting if possible.

The small trial pits and trenches should as he proceeds of course be marked down on his plan. From the comparative position of all those which show phosphate, or indications, he will find that there is a logical sequence of direction, and his previously acquired knowledge of the rocks themselves will enable him to locate the zone in which he has to operate.

He should above all things avoid the unnecessary sinking of big and deep shafts wherever phosphate shows may be found as has been the old custom, in the effort to raise a large quantity of phosphate immediately. It is only in very rare instances indeed that these costly shafts sunk down to follow shows have ever proved successful.

Mining companies have themselves been responsible for much of this wasteful kind of work by expecting their agents to begin and raise an immediate output the first year equal to that of the annual output of the best known and successful mines.

They themselves having been probably misled by the reports of these experts who have too frequently glowingly described them after only a hasty and superficial examination.

Mining for Apatite requires as much skill as any other mineral of equally difficult occurrence and it is better for the manager or agent to spend twelve months or more in correctly locating his mineral ground and developing it with a view to the future regular output rather than to immediate returns.

Having located his mineral ground his technical knowledge, no matter in what kind of mining it has been gained, will then enable him to estimate the amount of development work to be done and the machinery and tools most adapted to be purchased for his work ; and still better, he will be able to consider and estimate more accurately whether or not the prospects of his mineral ground are sufficiently promising to warrant the expenditure of his company's capital in permanent development work at all. In some cases it will be found that it is better to abandon his ground altogether at once and seek a new one.

Whereas had he adopted the old custom the capital of his company would at this stage have been considerably expended in costly shafts, etc., without proving anything more.

The writer's own experience is that the sinking of one deep shaft in properly located mineral ground is a better test of the whole property than half a dozen shallow ones put down at once and almost at random and before the agent could possibly have really understood his ground.

As it has been shown by experience that the largest deposits of Apatite occur at or near the cross dykes and may be reasonably inferred to continue so in depth, it may be assumed that no better spot could be selected at which to sink the shaft, keeping far enough away from the dyke to avoid striking its wedge-like angle at some depth down, and having to sink for the rest of the distance in the extremely hard rock of which these dykes are composed.

It is well to commence the shaft vertically if it is intended to be a permanent one and carried to a great depth, because it is more economical in the regular workings afterwards, for well known reasons—making cross-cuts at intervals to test the country rock.

A diamond prospecting drill bringing out cores is very useful for testing the ground as the shafts descend.

But if the lead has a considerable inclination, it is desirable and more economical to sink the shaft in the lead and at the same ascertained angle, because it would then be sunk in the pyroxene which is a comparatively soft rock and it would take in all the phosphate bunches which might occur and a more or less quantity of the ore might be raised, though unless these are very large it is not very profitable, as the ore is very much mixed with the debris of the shaft sinking.

In either case suitable provisions should be made in sinking the shaft for making galleries or drifts at intervals for testing the extent of the lead right and left, and for crossing into other paralell leads—and for permanent drifting and stoping should the ground prove rich. I may here state that phosphate lends itself very well to the operation of overhead stoping, and by an arrangement of head stalls the mineral may often be obtained very pure and unmixed.

If it is determined to sink a permanent shaft it is always advisable to erect proper buildings and machinery at the pit-top at the very beginning, because the economy and speed in sinking a shaft depends very much on the proper arrangement of air compressors, rock drilling, hoisting and pumping machinery.

In commencing a permanent shaft, consideration should be given to the question of fuel and water required for boilers and machinery used. If there is any water power in the neighborhood advantage should be taken of it, even if at a considerable distance away—the cost of long transmission pipes and loss in transmission not being of such importance as the permanent purchasing of fuel and its haulage up to the boilers for steam power.

Cobbing and Separating the Ore.—The old plan of breaking off the ore from the pyroxene and other impurities with hammers and the usual picking and screening is perhaps the most unsatisfactory and costly part of the whole question of winning the ore. It is an utterly crude and ill adapted method and until a mechanical method is worked out by which the ore can be separated and classified there is little prospect of phosphates being prepared cheaply enough to meet the requirements of low market prices, or even the rise which we hope for and anticipate.

The hitherto imperfect separation cannot better be shown than by the fact that while theorectically apatite contains 91 to 92 per cent of phosphate of lime, the highest grade of that now prepared for market does not exceed 80 to 86 per cent at the outside, while the second or lower grade does not exceed 65 to 70 per cent.

On account of the vein stuff and the composition of the impurities found mixed with the ore itself being almost alike in specific gravity it is a most difficult matter to achieve a satisfactory separation by mechanical means.

The writer has himself given special attention to this subject and has made innumerable experiments but with indifferent success.

It is however, a point well worth the consideration of manufacturers of classifying and separating machinery, who do not appear to have devoted much of their skill hitherto to the separation of mineralized phosphate.

In conclusion I would say that it is impossible to do more than give a general sketch of the apatite industry in such a paper as this but I trust that what I have said may elicit the views and opinions of some at least of the eminent geologists and mining engineers present here to-day on a subject which all will acknowledge to be of very great importance to the Province of Quebec.

CAPT. ADAMS—This paper, in conjunction with Dr. Ells' paper read this afternoon, gives us a very full insight into this subject Does any gentlemen desire to make any remarks upon it ?

MR. LEOFRED, (Quebec)—What is the price at which the phosphate can be produced per ton ?

MR. J. BURLEY SMITH—I cannot say exactly ; but from actual account of the whole thing, and having reached a fairly workable deposit, I have found it cost about seven dollars and twenty cents, say, roughly $7 a ton, having gone through the preliminary expenses of making cross-cuts, shafts, &c. This would be for two grades of ore, 85 to 86 per cent, and between 70 and 80. However, it may cost $10, $15, or $20, or even $30 a ton ; and, as Capt. Adams said, it might cost from 50 cents to $1,000 a ton. But I think that if it can be put on the railway at $7 a ton it will pay.

MR. MERRITT—I would like to ask, in view of the statement contained in Mr. Smith's valuable paper with regard to Apatite always being present in the pyroxene belts, in which it was said it had been brought up—how is its occurrence in great numbers of crystals explained, and also its occurrence in gneiss ? Because in my experience, which is not of course as great as that of many gentlemen here in actual working properties, but in examining them, I have found that if there is anything in creation that appears to be regular, it is the occurrence of Apatite. And further in regard to the occurrence in pyroxene belts, while acknowledging that it is nearly always found associated with pyroxene ore deposits, how can it be explained where Apatite is found entirely embedded in the calcite and also where you find it in pure gneiss existing in a gneissic formation with the gneiss ? I would like to ask these questions, because it would be of interest to me to know if that has been investigated in connection with the pyroxene occurrences.

MR. BURLEY SMITH—I may say from my experience that I have never found it imbedded in bunches or any other form whatever in the gneiss.

MR. MERRITT—I have seen in the Kingston district near Otty Lake what I class as gneiss, strings of phosphate occurring in a gneissic form with it.

DR. ELLS—I may say I have yet to find any case where gneiss itself contains Apatite, even in the Kingston or Quebec district. In the Kingston district, it occurs in limestone in the shape of detached crystals ; but in no case except in connection with pyroxene dyke.

CAPT. PENHALE—I have listened to Mr. Smith's paper with interest. But I think the question the gentleman on my left, Mr. Leofred, asked Mr. Smith was a very pertinent one : namely, what the price per ton would be. Mr. Smith got over that question capitally ; but it occurs to me that the price of mining this phosphate is regulated by the same consideration that enters into the the cost of mining other ores—that is, the nature of the bed of ore we have in the mine.

CAPT. ADAMS.—I have had fourteen years experience in phosphate ; and I have learned that the cost may be stated, as I have said already, to be from fifty cents to $1,000 a ton. I am glad to see we have with us Dr. Robt. Bell, of the Geological Survey, of Ottawa. Perhaps he has something to say on the matter ?

DR. BELL.—I have nothing to say except that I should like to hear Mr. Merritt's question answered, to give us a rule by which we can find profitable deposits of Apatite. I would say thaat lthough I have never seen Apatite in large quantities in gneiss, there is scarcely ever a microscopic slide of gneiss made which does not show it in the minutest quantities.

MR. F. C. SMOCK (New Jersey).—I might say that Apatite was mined many years ago to a small extent in Hurdtown, N. J., occurring in gneiss. It also occurs in a sedimentary form associated with magnetite near Dover, N. J., and in the well known occurrence of Apatite and Magnetite of Port Henry, N.Y. These occurrence of Apatite in true gneiss in the United States go to show, it seems to me, that perhaps we should not form too positive a rule in regard to the occurrence of Apatite in gneiss rocks.

DR. ELLS.—Might I ask what sort of gneiss this is ?

MR. SMOCK.—It is orthoclase gneiss.

MR. MERRITT.—If my memory serves me right, it was orthoclase gneiss, but not in workable quanties. And I asked how this was explained in the crystals in the calcite ; and not in workable quantities, as might have been inferred.

CAPT. ADAMS.—We are told by the scholars that the word Apatite comes from a Greek word, meaning to deceive, and I think it is well deserved.

The Electrolytic Extraction of Metals from their Ores.

MR. W. T. GIBBS (Ottawa).—We do not intend in this paper to refer particularly to any special Electrolytic process, but merely to indicate in a general manner the advances that have recently been made in Electro-Metallurgy.

More experiments have probably been made in the last few years on the Electrolytic extraction of Aluminium than on that of any other metal. In spite of the fact that articles are constantly appearing giving particulars of new processes for the extraction of Aluminium, we have yet to learn that any of them are successful even as experiments, to say nothing of their commercial aspects.

We have made a very large number of tests both with alkaline and acid solutions of Aluminium salts ; but in no case did we succeed in obtaining a deposit of the metal, and we think we are perfectly safe in stating that so far no method has been devised for depositing Aluminium from aqueous solutions of its salts.

The extraction of Aluminium by the use of the Cowles and similar Electrical furnaces cannot properly be called an Electrolytic process, for the reduction of the metal is probably due to the intense heat generated, and not to any specific electrical action.

The electrolytic extraction of copper is fast developing into a great industry and the next few years will undoubtedly see a contest between the furnace and electrolytic systems, in which the latter will surely be victorious wherever natural forces can be used as a source of power.

The process which seems to be based upon the best principles is one recently introduced by Hoepfner. In it a solution of cuprous chloride is submitted to electrolysis until one half of the dissolved copper is deposited. The remaining half is then present as cupric chloride and the solution containing this is run on to the finely pulverised copper ore, which has been placed in a series of led-lined vats. By a simple reaction more copper is taken into solution, cuprous chloride being reproduced ; which by electrolysis is again deprived of half its copper. By repeating this cycle of operations it is evident that the whole of the copper is removed from the ore, and is ultimately deposited on the cathode in a state of high purity.

One of the most important points in Hoepfner's process is the use of ferro-silicon as an anode, which is claimed not to be acted upon by nascent chlorine. Such an anode will do more to advance the electro-metallurgy of copper than any other improvement ; for hitherto the trouble has been that the anodes used were always attacked by the chlorine evolved during electrolysis.

Several other processes have been suggested and tried ; based mainly on the electrolysis of solutions of cupric salts ; but it naturally appears that the ultimately successful plant will be one in which a cuprous salt is used ; since the same quantity of electricity will deposit twice the amount of metal from such a solution as from one in which the copper is in the higher state of oxidation.

There is a large field for electrolytic separation in the treatment of the nickel copper ores of the Sudbury district, but so far attention seems to have been devoted chiefly to furnace methods of refining. There is no doubt, however,

that it is possible to refine the nickel-copper matte by electrolysis.

The first step in such a process would be to find an electrolyte which would be practically without action on nickel, and yet attack copper and dissolve it completely. The matte could be cast into plates and used as anodes in such an electrolyte. After the copper had been removed the anode could be recast and the nickel removed by treatment in one of the many nickel plating solutions.

It would seem to be very doubtful if it would be possible to treat the raw ore, without first roasting and reducing to a matte. The percentage of copper and nickel in the ore is so low compared to the amount of iron present that the solutions used would quickly become charged with iron, and it would therefore be impossible to deposit either pure copper or nickel, but in treating a matte this difficulty is reduced to a minimum.

Experiments have shown us that it is quite possible to remove the whole of the copper from a copper-nickel matte by careful attention to the composition of the electrolyte and the current pressure, and this without any appreciable action on the nickel present. The separation of the nickel from the remaining impurities is a more difficult matter, for the reason that the solution used attacks iron freely and the bath in a short time has to be renewed or freed from iron by precipitation.

We obtained some very complete separations by using a strongly acid solution as an electrolyte, and keeping it saturated with sulphuretted hydrogen.

In this way the copper was prevented from going into solution, whilst the nickel was completely separated, but here again we were troubled by the iron going into solution.

The only feasible method will doubtless have to be based on the preliminary removal of the copper and the after deposition of the nickel from the residue.

Another matter of great interest at the present time is the Electrolytic treatment of silver lead ores; although up to the present time very little seems to have been done in this direction.

In the Kootenay district water powers are abundant; electricity can be produced at a merely nominal cost, and the expense of maintaining and running an Electrolytic plant is far less than that of a furnace of the same capacity as is shown by the enormous development in electrolytic copper refining.

In depositing lead the greatest difficulty met with is its tendency to form trees or excrescences on the cathode; and it appears to be impossible to entirely prevent this, although by careful manipulation it may be kept within bounds to a certain extent.

Another difficulty is the tendency to the formation of a film of peroxide of lead on the anode, and thus preventing the solvent action of the electrolyte; but this is much more easily obviated than is the first mentioned trouble.

Not a few attempts have been made to refine base bullion by electrolysis, but so far as we are aware none are in successful operation.

For such a process to be of any practical value it appears to us that it should be capable of taking the raw ores and treating it directly in the electrolytic cells, without intermediate reduction in a furnace.

With copper-nickel ores we do not think such a course possible, for reasons already given; but in dealing with a practically pure sulphide of lead, or of lead and silver, the question of impurities does not arise.

Some experiments which we have made on the Electrolytic treatment of raw galena have been fairly successful.

The ore is finely pulverized and laid on a carbon plate which forms the positive pole, and at the same time, the bottom of the electrolytic cell.

The Electrolyte used was a saturated solution of nitrate of lead in sodium acetate, used at a temperature of 40° to 50° centigrade.

The cathode used was a plate of iron, suspended horizontally over the anode, the lead being deposited on the lower side of it. At first it seemed as though it would be impossible to obtain a satisfactory result, for the lead came down in spongy flakes, and the anode was continually getting coked with peroxide, but by a careful adjustment of the temperature and current intensity we at last succeeded in obtaining a fairly dense deposit of lead.

The whole of the lead is dissolved out of the galena and deposited on the cathode in a high state of purity, some samples giving as high as 99.97% of metallic lead. The silver remains at the anode, together with the whole of the sulphur, as a residual mud, from which it can be removed by treatment with a cyanide solution. The sulphur can be afterwards melted and cast into rolls; in which state it is worth from $28 to $32 per ton.

A plant to produce two and a half tons of refined lead per 24 hours would cost about $7,500; and the running expenses for that time would be about $15, where water power was used.

The production of chlorine gas by Electolysis, for use in the chlorination of gold ores, is now being carried out very successfully in Australia; and could probably be utilised in treating the Ontario and North Carolina gold ores with equally good results.

Probably no metal is more difficult to extract electrolytically than zinc. It will persist in coming down in a spongy form, and no amount of care seems to stop this, for it invariably commences the moment the deposit attains an appreciable thickness. In the case of lead this spongy deposit does not greatly interfere, as the mass can easily be melted and cast into pigs; but the spongey zinc absolutely refuses to melt.

Each particle apparently becomes coated with a film of oxide, and this effectually prevents their fusing together. This spongey zinc oxidises so easily that if immersed in water it slowly decomposes it, with evolution of hydrogen; and another curious fact about it is that it will take fire spontaneously if exposed to the atmosphere after it has been dried by pressure between filter papers or a few folds of cloth.

From time to time reports are heard to the effect that the manufacture of iron will shortly be carried out in electric furnaces, but the absurdity of such statements is apparent to anyone with any knowledge of electro-metallurgy. Iron is so cheap that an electrolytic process could never begin to compete with the old blast furnace.

The subject of electrolysis on a large scale is an entirely new one.

Electrolytic methods for separating metals have been in use for many years in laboratories, and now that the developments of electrical machinery have made it possible to produce enormous quantities of electricity at small costs, a new order of things has arisen and a new scientific field is opened to investigation.

So far we only see dimly the possibilities of this new agent and for many years the failures will be many and the successes few; but enough is already known to make it safe to say that electro-metallurgy is the metallurgy of the future.

The experimental stage, is, however, being pushed forward as rapidly as possible, notably in the treatment of copper ores, but as we have already indicated, electrolysis will probably be of equal value in the treatment of silver lead ores and in the separation of copper and nickel.

Next to copper and nickel; silver, lead and antimony will probably be the first metals to be commercially extracted by electrolysis; next to them tin and zinc, but in the treatment of the last two many difficulties are encountered which are not met with in the first mentioned cases.

We are now having built by Messrs. Crompton & Co., a dynamo to give a current of three thousand ampères at a pressure of twenty-five volts; and which will be used in working our electrolytic processes on a manufacturing scale.

We believe that by working in this manner much more certain and reliable results can be obtained than by working on a small scale; this machine will, in fact, supply a sufficiently large plantt to give commercial as well as scientific figures.

In a short while we hope to report a successful process for treating silver lead lead ores; which we think would be of great value in a mining country like the Kootenay; where water power is so abundant and so easily developed.

CAPT. ADAMS expressed regret that the author was not present. He invited discussion; and

PROF. C. GORDON RICHARDSON, (Toronto) said:—There are many questions in relation to the treatment of Nickel and Copper mattes by electrolytic methods, that I should have wished to put to the author himself had he been present. The question of treating such mattes electrolytically is one, I think, agitating all those who handle such mattes. The trouble pointed out by Mr. Gibbs in his paper of the iron entering into the electrolyte, is in my opinion, of minor importance. I think that even in the case of ordinary mattes obtained in the furnace treatment, excellent results could be obtained by precipitating first, copper, and allowing the iron and nickel to go into solution; and then per oxidizing the iron by any of usual methods and precipitating it, leaving the nickel solution to be treated by any of the ordinary methods for separation. It is a pity, I think, that Mr. Gibbs did not give us in his paper, some figures in regard to the pratical cost of separating the different metals in the mattes by electrolytics.

DR. RAYMOND:—Mr. President, my attention has been attracted to one or two points in this paper, and in the first place to the statement at the very outset, that the electric process by which aluminum is now produced could not be fairly described as electrolytic. That statement is true as applied to the Cowles process; it is true in that process, as Mr. Gibbs has stated in his paper, that the reduction of alumina is performed at a very high temperature and in the presence of carbon, and may fairly be called an ordinary reduction by smelting; but that is by no means the case in the Hall process, which is the successful process in the States by which aluminum is now manufactured in large quantities, on a working scale, by which the price of aluminum has been brought down to about 50 cents a pound. The current is not over five to eight volts. The heat is very low. There is no way of interpreting it as a reduction by heat or a reduction by carbon. There is a bath of double chloride and fluoride. In that bath pure alumina is reduced. The bath remains practically unaltered. So I should object to Mr. Gibbs' statement that there was no electrolyte process for reducing aluminum, althought it is true there is no successful process for its electrolyte reduction from an aqueous solution of any of its salts. It is true, as he says, that we have not succeeded in making an electrolytic reduction of base bullion, (silver and lead). It was tried many years ago by Mr. Keith, and our best metallurgists do not like it; they do not think it is equal to other methods of refining. What surprises me is that Mr. Gibbs should think that he could do better with silver combined with galena than with silver and lead; for if he starts from the proposition that he cannot handle base bullion, then I do not understand how he gets any encouragement about the ores. When he says he can do it with pure galena, I am reminded that he will not get pure galena in practice, but must handle galena with zinc blende and pyrites and a great many other disagreeable ingredients.

MR GARRISON.—I do not agree with Mr. Gibbs; for while it is excellent for many special purposes, more particularly the refining of metals, its application to raw ores is attended with many serious difficulties, which I doubt it is possible to overcome. Furthermore, the resources of thermo-metallurgy have been by no means exhausted. The subject of thermo-chemistry, which is the true basis of furnace metallurgy, has been very slightly studied. It therefore contains great possibilities of which we can form but little idea. A case in point, I will take the liberty of saying, was the substance of a paper read by me yesterday before the American Institute of Mining Engineers, upon the production of metallic manganese free from carbon, in which the metal alumina is used as a reducing agent. Heretofore, carbon in the form of coke, coal or gas has been our sole reducing agent. It is therefore possible that other reducing agents may be discovered which will in a measure replace carbon. Of course it should be understood that we will probably never have any agents with which to reduce ores from their raw state to compare in cheapness with carbon.

MR. FRANCHOT—I have nothing to say about the paper. I am very sorry Mr. Gibbs is not here to-night; but he is in Ottawa, and he will be here to-morrow; when I will make it my business to hand him over to the tender mercies of the gentlemen, and I will pick up the pieces and carry them home.

MR. MERRITT—The discussion has gone upon reducing agents. This is a matter of very great importance to us here. In our Lake of the Woods district and the Madoc district we have very refractory ores. If they could be used as has been done in Montana, and I believe, Colorado, in making use of the pyrites and the sulphur as a reducing agent, and the iron too, to some extent, it would be extremely valuable. If any of our American friends, who happen to be thoroughly conversant with sulphur and pyrites as a reducing agent, could give us a few notes on that, it would, I say, be extremely valuable with regard to our local refractory ores existing in the districts I have mentioned.

MR. GARRISON—I would say that I have been occupied in defining two reducing agents. We did not discover the fact that aluminum was a reducing agent; but merely took advantage of a well known chemical fact and used it. We did the same thing with silicon. Previously the only use to which sulphur had been put was to generate the heat in roasting the ores. I should be happy to examine some of that ore referred to for the gentleman in the future, and if we could add still another reducing agent to our list we should be more than gratified.

PROF. RICHARDSON—In speaking of reducing agents, I find myself somewhat at sea when brought in contact with silicon and aluminum as reducing agents. The question to practical metallurgists is: What is the cheapest reducing agent? I do not think that we will be able to supplant carbon, except in special cases; for in the first place we have to reduce silica or aluminum before you can use it in its turn as a reducing agent. Sulphur has been suggested as a reducing agent by the English metallurgist, Barks, in a process for which he has obtained a patent in England and other countries. This applies to the reduction of nickel silicates in the new Caledonian ores, by the addition of sulphur or compounds capable of giving up sulphur to the nickel ores; and the metal is precipitated as nickel sulphide in the form of matte.

DR. RAYMOND—The question that the gentleman on my right asked had reference I suppose to the pyritic smelting which has been carried on in Montana and Colorado; and so far as the last speaker's remark is concerned, I perhaps as the secretary of the American Institute of Mining Engineers, should come to the rescue of my friend, Mr. Garrison, and say that his use of aluminum is for the manufacture of metallic manganese, in which they want to keep the carbon out. So far as pyritic smelting is concerned, I don't believe we can consider that sulphur plays any reducing part, for it takes no oxygen from any ores. We reduce the ordinary pyrites to a lower sulphide, take out part of the sulphur, and by burning that, melt the rest, and get up heat enough to flux the earthly impurities by adding quartz. You cannot do that unless the ores will permit. The thermal calculations show a very narrow margin, so narrow that it is considered necessary to have an outside means of heating the blast. With a blast, heated outside with an independent source of heat, pyritic ores of a certain quality can be matted, and the earthy impurities fluxed off at the same time, and all without putting any fuel in the furnace. Half of the sulphur that is in the ore acts as fuel. The process, I believe, is now running in Colorado and Montana; and the company has established a headquarters in San Francisco and is now engaged in hunting up pyritic mines that suit the process. It is not suited to replace our ordinary methods of roasting and smelting ores containing lead.

Notes on a Recent Visit to West Kootenay, B. C.

CAPT. R. C. ADAMS, Montreal—As the title implies, this paper consists of notes upon a visit and not notes upon West Kootenay. By the selection of this theme I am relieved from the necessity of repeating the geological descriptions which will be found in the reports of Dr. George Dawson or the account of recent developments which has been given in so interesting a manner by Mr. Charles F. Lain in the last number of the *Canadian Mining and Mechanical Review*. All who are concerned will find in print full information upon these subjects from the best authorities. All I need say is that in the District of West Kootenay many discoveries of silver bearing ores and some of gold have been made and that each year a new region is opened claiming to be richer than the last.

Interest at first centered around Toad Mountain near Nelson, where the famous Silver King mine was opened up and 1½ millions worth of ore proved to be in sight. Next the Hot Springs or Ainsworth District showed its treasures. After this the Slocan revealed large deposits of high grade ores and no sooner were these being developed that news came from the Lardo of great finds; and reports from other districts show that over a large extent of country there exists a profusion of veins of argentiferous galena so great in quantity and high in quality that the people predict Kootenay will become the great silver producing region of the world.

As one approaches the district he meets the outlying prospector, who informs him that a visit to the wilds of the Kootenay is needless, as he owns the best claims yet discovered and owing to necessity will sell them for a song, only a few thousand dollars. But pushing on to Nelson, more prospectors are met who have more of the very best claims at still lower prices, and the real estate man tells you that the way to get rich is to buy town lots, proving his case by the information that a corner lot in Nelson, bought four years ago for $100, has just been sold $4.000. In the month of March last I arrived at the town-site of Kaslo, where lots can be had for $50 to $100, the town then consisting of two houses, an unfinished store and numerous tree stumps. But in October I found there more than 50 houses; the $50 lots have become worth $500, and there are rumors of corner lots being sold for $3,000.

Kaslo is the western gate to the Slocan region, and a trail of thirty miles leads to the trail up Carpenter Creek from New Denver and along this stretch of forty miles, but chiefly in the middle twenty miles lie the many "bonanzas." Hiring a cayeuse, that you are assured will not buck, but who terrifies you with what are said to be "playful antics" when you first mount, you slowly walk the animal along the rocky trail through the dense forest, where pines and cedars in interminable procession rear their stately forms. One needs a steady head to ride along the edge of the sheer precipices sloping away for a thousand feet and confidence is not increased by seeing below the dead carcase of a horse that the day before by one false step rolled down to destruction. But some assurance is gained upon meeting a horse that the pack-driver tells you rolled over and over for 300 feet down a slope that day, with 250 pounds on his back; and the only record is a cut on the mouth that gives to his face the expression of a self-satisfied smile, as of one who is proud to have done what few cayeuses have ever lived to hear told. At night one is glad to find shelter in a log cabin; but with potatoes at ten cents a pound and hay at $60 a ton, rations are limited for both man and beast. The pony is left to browse on the leaves and shrubs, and the man is treated to bannocks, pork and beans and tea. The next morning a start is made on foot up the sides of a mountain whose head pierces the clouds at an elevation of 7000 feet. Many weary hours are spent slowly climbing by the so-called trail, across which the great fallen trees lie as barriers or sometimes serve as dizzy bridges across deep ravines, whose rocks promise death for a slip. A plant called Devil's Club grows profusely through the under-brush and if the barbed thorns enter the flesh there will be sorry time before they get out. Towards night the summit is reached and after the bannock is baked in the frying pan before the log fire and the beans are boiled, the bacon fried, the miners and visitor satisfy their hunger and exchange reports of mineral wonders for the news of the outside world. Four men sleep side by side on fir-boughs in a tent six feet wide, and in the morning in a cold rain they start out to see the prospect. A snow slide has cleared the ground and down this ravine runs a vein ten to forty feet wide streaked with seams of galena, varying from two feet to a few inches in width, but so plentiful that the whole mass would concentrate one half mineral. Tracing this vein over an exposure of 400 feet, the summit is climbed and descent made down the other side to where a cross cut has revealed a solid vein of galena three feet in width, and the belief is expressed that the ore runs all through the mountain from one side to the other and "there's millions in it." Descending the mountain the smooth shoes of the tenderfoot slip upon wet surface; many falls are experienced and the quick firm grasp of a miner only saves him from rolling down the gully.

In other locations strong veins are seen; and the great galena boulder of 66 tons that has rolled down the mountain from the vein above. Assays are reported giving from $50 to $10,000 to the ton and an examination of an assayer's book at New Denver shows that 260 assays, varying from a trace to 1,500 ounces, gave an average value of 250 ounces of silver per ton.

In the latter part of the fall a wagon road has been built from Kaslo, some twenty miles, and will be extended in the spring, and the railroad is soon expected to follow. Although it now costs $75 per ton to mine and ship ore to the U. S. smelters it is believed that the cost will be reduced to $20, and if the ore averages for silver and lead a value of $150 per ton as has so far been proved and the smelting charges are not over $20, there will remain a profit of over $100 per ton, and if the output is from 10 to 15 tons a day the returns will soon build up fortunes. Miners ifs are proverbially uncertain and if the veins prove small and do not go down, and silver does go down in the market and capital is discouraged from providing transportation, the one ton daily sent down the mountain on ponies' backs and costing over $100 to market, will only serve to buy another tombstone for a broken hearted "busted miner." Some scholarly young men from the School of Mines declare that the minerals will not he found at depths, and hundreds of good prospectors from Montana and Idaho found nothing on the surface and went away disappointed. But numerous diligent seekers have been rewarded and many of the men met with on the trail or in the "half-way" cabins at night pull out of their pockets fine specimens and tell of the great veins of rich ore that exist on the claims they have located.

"A careful study of the Kootenay district, during two visits the past year, convinces me that while many of the mineral grades, are narrow, pockety and of low grade, there are enough that are wide, continuous, and of high grade to ensure a large output of good value. For a mining region the possibilities for transportation are exceptionally good. The Slocan mines lie midway between the two systems of water carriage, on the Arrow and Kootenay lakes. Wire cables, (aerial tramways), can bring the ores to the valleys, and wagons, tramways or railways, can take them to the water, and later on direct by land to the smelters. Nature has done her part in bestowing upon British Columbia, great stores of mineral wealth, and providing the routes for transport. A great and speedy development may take place, which will greatly add to the prosperity of the country, and the wealth of many individuals, could man follow nature's leadings and permit industry to pursue its intelligent bent unhampered by the fetters of fiscal laws and special privilege. Nine-tenths of all the people working in the district are from the United States. Nearly all the capital is supplied from that quarter. The best mining machinery is made in Chicago, and San Francisco. The mine owners naturally wish to buy the supplies with which they are familiar and make their purchases in their own country. Numbers of smelters have been built in Montana and Washington, and these want the lead ores to use as fluxes with the dry ores from other localities, and can afford to work them at low prices on account of their desirable character. All parties wish to see railroad communication established with the South, and they see that this is essential to the growth of the district. Three great factors are left for man to provide to supplement nature's bounty and realize the vast treasure of wealth now locked up in the massive and inaccessible mountains. These are mining supplies, smelting facilities and railway transport. But what do we see? Incredible sight in a so-called age of freedom in the end of the 19th century on the continent of America, liberty's vaunted birthplace. Three officials, each wearing a badge labelled "Patriotism," stand at the Boundry Line and by their exactions paralyze the efforts of the earnest and enterprising workers. The first official seizes the mining supplies and demands one-third of their value in the name of the Crown. The second official stops the ore and says that his Uncle Sam must have $30 a ton on all the lead. The third official says all Canadian products must be moved through Canada by Canadian railways; no transport facilities to the South must be permitted. So timid capital hangs back, and the country languishes waiting for a brighter day and a wiser generation, when industry will not be taxed and men will cease to hinder the worthy efforts of their fellows.

The Canadian Government, seeing in some measure the injury of the tariff to the mining industry, has allowed free entry of mining machinery of a kind not made in Canada. But most of the ordinary articles are made in some fashion in Canada, or else some village blacksmith will pretend to make them, and the concession is of doubtful value. The smelters of the United States are demanding free lead, for they see capital going to build rival smelters in Mexico and Canada. In this case both countries are injured by the restriction, for although a quarter of a million of N. Y. capital has been expended in building a smelter in the Kootenay, the facilities of the U. S. smelters are also needed. Owing to a policy which never permits railways nor builds them, a great district in which the population has increased five fold within a year has been left during the winter without communication except by a horse trail for sixty miles in one direction, and long sleigh roads in another. Serious fears of famine have been entertained, and the development of the country has been seriously retarded by the difficulty of ingress and egress.

But indefatigable men are triumphing over both natural obtacles and human opposition, and a railway from the South will be completed to Nelson this year. If further hindrance to transport ceases, and if the Governments of the United States and Canada will remove their duties upon minerals and mining supplies, a future for British Columbia will open, surpassing the fondest hopes of those who first bound her in the family bonds of Canadian unity. But it is wise to say and give warning, and that without any reference to party politics, that unless the cry of British Columbian workers, "hands of" is heeded, there will be likely to come a breaking of the nominal tie that binds that country to her eastern relatives two thousand miles away, and she will affiliate in name, as nature has destined her to do in fact, with the populous and prosperous regions that adjoin her to the south.

But let us hope that wisdom and justice joined to that love of freedom which is the strongest sentiment in the Anglo-Saxon breast, be it under the Union Jack or the Stars and Stripes, may so determine the course of both nations that human effort may be unhindered, and the wealth of British Columbia's mountains may make glad the whole continent of Columbia."

The hour being late, the following papers were read by title:—

"Notes on the Mineral Resources of New Brunswick," by W. McInnes, Ottawa.

"The Future of Mining in the Province of Quebec," by J. Obalski, Quebec.

"The Iron Ores of Frontenac and Leeds, Ont.," by J. Bawden, Kingston.

"The Bog Iron Ores and Ochres of Champlain County, Que.," by A. P. Low, Ottawa.

"The Manufacture of Charcoal Iron from the Bog and Lake Ores of the Three Rivers District, Que.," by P. H. Griffin, Buffalo, N.Y.

A Series of Papers by Members of the Mining Society of Nova Scotia on the Modification of Working Coal, lately introduced in the Province of Nova Scotia.

"The Crawford Gold Mill," by Capt. MacDuff, Waverley, N.S.

These will be reproduced in full in the next issue of the Review. The meeting then adjourned.

The Works of the Canada Iron Furnace Company at Radnor, visited by Delegates to the International Mining Convention.

The proceedings of the International Mining Convention terminated, on Saturday 25th February, with an excursion to the works of the Canada Iron Furnace Company, at Radnor Forges, Que.

The Company was formed in 1889 for the purpose of acquiring the iron interests of the district of St. Maurice, including iron works at Radnor Forges, together with all accessories, such as a village of sixty workmen's cottages, limestone quarry, perfected water power, clay pits, railway line, bridges, sidings, and other valuable property; also car wheel shop, and shipping dock situated on the River St. Lawrence at Three Rivers, Que.; property forming site for permanent battery of charcoal kilns, together with water power on the River St. Maurice, at Grandes Piles, Que.; ore deposits of Lac-a-la-Tortue, together with ore rights, over 100,000 acres of ore bearing lands and lakes at other points in the district of St. Maurice and vicinity.

After operating the antiquated stone stack at Radnor Forges (capacity 4½ tons per day), for some two years, in an experimental way, the Company proceeded to develop the entire property, systematizing the collection of ore and wood, by establishing ore depots, wood camps, charcoal kilns, etc., at the most desirable points throughout the territory controlled by them, and finally building at Radnor a modern blast furnace plant, complete in all necessary details, and capable of producing every day from 40 to 50 tons of high class charcoal iron.

The furnace is splendidly situated in the very centre of the ore fields, and in close touch with the wood limits, not only of the St. Maurice, but of the vast territory extending to the north and south of the river, which is, as yet, primeval forest.

The Riviere-au-Lard, on the bank of which the furnace stands, affords an excellent water power for operating ore and stone crushers, for pumping water to the furnace belt, for fire protection, and other necessary purposes. The waste gases of the furnace are utilized for fuel, and the plant itself operated therewith. The immediate plant consists of the following:—

Furnace Stack.—Height, 40 feet; bosh, 9 feet diameter crucible, 5 feet diameter; height of bosh line from hearth, 13 feet; 4 tuyeres of 3½ inch diameter.

Crucible and bosh from mantel ring down is encased and protected with Russell Wheel and Foundry Co. water jacket.

Furnace top is provided with a bell and hopper, capacity of which is 25 bushels.

Hot Blast Stove.—This is of the pipe pattern, with a combustion chamber below. Dimensions are: Length, 24 feet; height, 18 feet; width, 9 feet 6 inches. Sixty-eight openings between combustion chamber and pipe chamber above.

Steam Power.—Consists of four steam boilers, each 4 feet diameter by 25 feet long, with two 18 inch flues; shells are of ⅜ inch plate and double riveted. All boilers connected with a brick chimney 75 feet high, and all are bricked separately, and arranged to fire with either wood or gas. Gas connections are made so that boilers can be worked in batteries of two each or more, and one or two can be laid off for repairs or cleaning at any time.

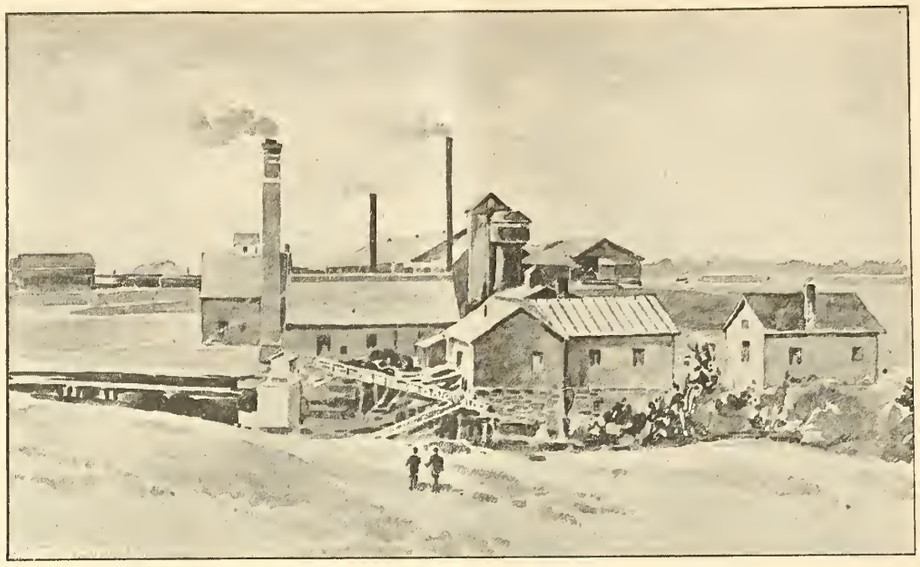
Water Power.—This consists of a head of 24 feet, with a "New America" wheel 35 inches in diameter, capable of delivering 65 horse power.

Blowing Engines.—New Weimer blowing engine, size 16 x 48 x 30, set up on a solid stone foundation, which rests on a limestone bottom. This engine is provided with a patent water heater and a Scanlan patent wind receiver and heater, capable of raising the temperature of wind to about 200 degrees Fah. before entering the hot blast stove.

Auxiliary Blowing Engines.—These are of the horizontal type, with two cylinders, each 40 inch diameter by 46 inch stroke, and are geared to be driven either by a horizontal steam engine of 14 x 20 inch cylinder, or by water power. These engines are complete with their own wind receiver and pipes, and are so arranged that they can be used in case of an accident to or a shut down of the Weiner engine. They deliver about 2,100 cubic feet of air per minute, with a pressure of 4½ pounds. The whole is set up in an engine house entirely separate from the Weimer, and is isolated from the latter and the boiler house.

Steam Pumps.—One Blake duplex pump, 12 x 7 x 12; one Holly boiler feed pump, 8 x 10 x 4; one Niagara boiler feed pump, 6 x 4 x 6; one Northey volume pump, 6 x 5 x 7.

Force Pumps.—One horizontal force pump, 4 x 8; one



Furnace Works of the Canada Iron Furnace Co. at Radnor Forges, Que.

CANADA IRON FURNACE CO., Ltd.

Geo. E. Drummond,
Managing Director and Treasurer.

Thos. J. Drummond,
Secretary.

John J. Drummond,
General Superintendent.

Battery of Charcoal Kilns at Grandes Piles, Que.

double-acting Plunger force pump, 5 x 10.

All the above steam and force pumps are so connected that they can be used either on the furnace water jackets, tuyeres, for general fire purposes, or for boiler feed.

All the suction pipes in connection with new engine house are laid through a stone tunnel, which leads from engine house to river, and are always beyond the action of frost, and so arranged that alterations and repairs can be made at any time, as the tunnel is large enough to allow a man to pass or work.

Hoisting Power.—This consists of a Crane pattern double cylinder hoisting engine ; size of cylinders, 8 x 10 inch. This engine is connected with two hoisting cages, having a lift of 15 feet from floor of weigh-house to floor of top-house.

Charcoal Kilns.—Radnor Forges Battery consists of :—

8 rectangular kilns, capacity 55 cords each ; 3 beehive pattern kilns, capacity, 55 cords each.

Grandes Piles Battery consists of :—

14 beehive pattern kilns, capacity, 55 cords each. Others in course of construction.

Charcoal also made and supplied from pits in the Sweedish manner.

The buildings and real estate in connection with the entire plant is the property of the Company in fee simple.

Ore Supply.—Investigation carefully carried on by practical men, under the immediate direction of the officials of the Company, and verified by actual work in the field, has proved beyond a doubt that there is not only an abundant supply of ore in sight to last for many years to come, but that it is steadily grow-ing, and new discoveries are being made daily. These ores of course vary in analysis, but the supply is so large that the Company are able to make such selection from the vacious deposits as to be able to produce fixed results. The Company have their own laboratory, and a practical chemist is permanently employed in the selection of ores, and the analysing of the furnace product.

Limestone.—There is a splendid limestone quarry side by side with the furnace, furnishing a valuable flux at the minimum of cost.

Charcoal.—The Company have two batteries of kilns, one situated at Radnor Forges, and the other, the main battery, at Grandes Piles on the River St. Maurice. The supply of hard woods suitable for charcoal making is almost inexhaustible. The main kilns located on the Company's property at Grandes Piles can draw supplies from the banks of the St. Maurice for half a century to come. The location of these kilns secure to the Company the practical control of the navigable waters of the St. Maurice, Grandes Piles being the terminus not only of the railroad but also of navigation. The Laurentian range of mountains presents a barrier to the railway going farther north, whilst the succession of magnificent water falls and rapids between Grandes Piles and Three Rivers absolutely prevents the navigation of the St. Maurice to the south. This property also gives the Company control of the Grandes Piles Falls, which with a drop of 40 feet has a volume of water representing a power not less than 35,000 h.p. It is difficult to estimate the value of this great natural water power. Naturally it is much enhanced by the fact that it occurs at the junction of railway and navigation, and sooner or later its development will offer a splendid investment.

The vast territory to the north watered by the St. Maurice and its tributaries and estimated as 200,000 square miles, contains an immense quantity of pine and spruce, and at the present time its limits are attracting the attention of American capitalists, as evidenced by the fact that the American Laurentides Pulp Co. have already expended hundreds of thousands of dollars in the erection of a pulp mill and in perfecting the water power at Grande Mère, a few miles below Grandes Piles. Aside from the manufacture of pulp, the lumber produced from the spruce of the St. Maurice is of a class coming more into use every day, as taking the place of the more expensive pine. Hard woods, such as maple and birch, are to be found in an almost inexhaustible growth all along the banks of the St. Maurice, and are specially suitable for the manufacture of charcoal for the smelting of iron. It is from this section the Company will draw its supplies for some years to come, and with great benefit not alone to itself but also to the settlers on the river, who find that in clearing their lands they are able to chop and dispose of their standing wood to the Charcoal Works at good paying figures, thus finding a cash market for what would otherwise be to them practically worthless material.

In addition to the valuable ore deposits and wood limits controlled by the Company they possess rich deposits of ochre, suitable for metallic paint, and also (on the property at Radnor Forges) valuable clay deposits suitable for making the finest quality of re-pressed brick.

The work of bringing the furnace plant and accessories to its present condition has been no easy task, and if in many respects Radnor Forges may seem to be behind American furnaces at the present moment, yet given sufficient time for a further development and proper systematizing, there is no reason to fear but that the works will eventually make a very creditable showing. American furnace men, the majority of whom are able to purchase their raw material, such as ore and charcoal, in the open market, will appreciate the difficulties of establishing a new furnace in what may be termed "The Wilderness." The Canadian furnace man has, so to speak, "to live within himself," to provide workmen for his entire cut of wood, to transport same to his charcoal kilns, and the charcoal to the furnace. He has also to "mine" his full supply of ore, and other necessary material. All this the officials of the Canada Iron Furnace Co. have had to do, and the greater part of the reorganization and systematizing has been carried out within the space of one year, and that too concurrently with the construction of the plant itself.

Among the serious difficulties the Company have had to contend with, was the fact that owing to stagnation in the lumber interests of the St. Maurice district, there was at the time of the inauguration of the Company, a great scarcity of labor, the workmen having left the country in large numbers. Further the officials had to contend with great difficulties in their attempt to change the weights and measures that had been in vogue in this territory for many years, for instance, the *habitants* at first positively refused to supply wood of greater length than three feet and the Company desiring to be in the same position as their American competitors had to set to work to change this to the present standard of four feet, in the face of considerable opposition from the *habitants*. These alterations have been carried out without undue friction, and the American standard is now used in all departments. Furnacemen will fully appreciate the difficulties referred to.

In carrying out all the operations of the Company, upwards of 800 men are directly and indirectly employed during the season, the majority of whom are engaged in the securing of ore and wood supplies. Through proper systematizing the Company's employees are now taken largely from the ranks of the farmers or *habitants*, who work for the Company during their slack season between seed time and harvest, and in the winter months. These men find the work profitable in clearing their lands by supplying wood to the charcoal kilns, and in raising ore on portions of their farms which would otherwise be unproductive. In this way the work of the Company goes on almost continually over a very large territory, and the supplies of both labor and material so obtained are therefore now practically unlimited.

The Excursion.

(By our Junior Reporter.)

To have your "innocent sleep," the sleep that has "knitted up your ravelled sleeve of care," broken by a fusilade of vigorous knuckles upon your door ; and to rise from a comfortable bed at half-past six, a.m., when you are not in practice for the seeming hardship, appears an action, heroic in itself, which should require some strong and alluring incentive. One remembers, doubtless, the time of life when we rose at five—or earlier, if the sun set the example, for we never let him get ahead of us in those days—to go fishing with some Tom Sawyer or Joe Harper, of our youthful and adventurous bosom. But that was very long ago, we think with a sigh, as we grope sleepy-eyed for our watch, For we want to see the time, to make very sure that the porter is not making us get up an hour too soon ; and who still lingers outside, not feeling quite certain that we are up. But our chronometer has stopped in the Waterbury watches of the night ; and so we viciously pull on our clothes and shout to the doubting Thomas outside that we are up, feeling the case is quite hopeless, and that the incentive is too potent to admit of even dreaming of going to bed again—and dreaming.

For the reward of this particular morning is the long talked-of trip to Radnor Forges ! It is a glorious day, anyway, we say, as we wrestle with our refractory collar stud, and look out of the window at the God-given sunshine laying its long golden fingers caressingly upon the white tresses of the dying Winter. We are dressed at last, as the ladies say, and we hurry down and get breakfast; and, half an hour later, are aboard the excursion train gliding out of the old Dalhousie Square (Canadian Pacific Railway) station on this brisk Canadian morning.

The excursion train in question left Montreal about 8 a. m. with a jolly, rollicking lot of representives of the American and Canadian Mining Associations. There was a fair element of ladies, too, on board, serving as a sort of sprinkling of delicious perfume upon the kerchief of pleasure ; and tempering with their fine eyes and presence the men of steel. Hygeia and Boreas appeared to have been propitious to the excursion ; for every individual on the train seemed the embodiment of good health and spirits, and the old North Wind god had gone himself on a holiday of his own. It was one of those still, white Canadian days when all the earth seems wrapped in a mantle of dazzling sunshine, and which makes the visitor of sportsman-like proclivities, experiencing it, exclaim hungrily : Gad ! What a day, and what a climate ! Say, you fellows, would't you like to be out there with pair of snowshoes on, after some game, with Ed. W. Sandys for a guide?

Continually passing through the cars to see that each one is thoroughly enjoying himself, the hosts of the occasion, Mr. T. J. Drummond, and his brother Mr. G. E. Drummond, of the Canada Iron Furnace Company make everyone feel perfectly at home ; if such an expression can be used in relation to such an unstable business-like affair as a train. About eleven o'clock a luncheon, that was a little poem in itself, punctuated by the popping of numerous corks, was served ; and between twelve and one o'clock Radnor Forges was reached.

Here everyone alighted, and went and saw and was conquered. To one conversant with the technique of an industry such as that of the Canada Iron Furnace Company, the visible working of that industry and the evolutions of the ore must of necessity be intensely and specifically interesting. But to a novice, to one who has only partially understood and appreciated the value and vastness of a great industry, the visible working in question has a peculiar charm. He realizes that he must *see* to understand and to estimate fairly.

The party first visited the casting-house where the ore come down from the furnace and is run off into pigs weighing about 150 pounds. There were about 200 or more of these pigs in this one building alone, lying in their little graves of earth which the workmen were throwing upon them, and looking to the wide-eyed treasure dreamer in their great heat like so many bars of red gold. Miss Poulin's famed hidden wealth would be as nothing to it !

Then we all went up to the furnace, crossing at a leap on our way the stream of hot slag that flowed away to the side of the building, and that made one think of the lava of a volcano. Here, at the furnace, we saw the bog ore and the charcoal and the limestone poured liberally into the gaping mouth of the funnel-like throat of the furnace, that seemed a veritable insatiate dragon, whose breath was flame.

Later on we adjourned to the new and neat little Episcopalian church, which had not at that time been opened. It is a bright little building, built for the accommodation of Episcopalians and Roman Catholics alike, the Roman Catholics attending the Church of England service held in the Sabbath evenings. It is capacious, too, this church, for no one would have thought by an exterior glance that it could hold such a number of excursionists and villagers as flocked to it on that memorable occasion of the 25th February.

So we all filed in and took our seats, and Capt. Robert C. Adams of Monteal, took the chair.

THE CHAIRMAN—After mentioning the fact that the gathering had only a very limited time to spend in the church and listen to the gentlemen who were to speak said : "We are met in this church to do honor to an industry which has existed for many years, and which has come to a joyous condition of being ; and we believe that under the able and continued management of the gentlemen of whom it has been our very good fortune to be the guests to-day, there is a very great future before this industry. We can but regard these gentlemen as philanthropists, who, by the medium of such an industry, provide a means of livelihood to many people, and help to sustain and elevate the vigor and industrial greatness of a country. I say it is right that a celebration should be held in a church in honor of an industry which is so closely united with the sentiments and practices of philanthropy. I observed in the admirable souvenir which these gentlemen have prepared for us that this delightful and romantic region is also likely to prove one of advantage to the treasure hunter ; and I now understand why we had such an easy journey down here this morning, because I am reminded of an old saying : *facilis decensus Averno.* But now that we have taken refuge in a church we shall escape any advances which his Satanic Majesty might be pleased to make.

I have received letters of regret from the following distinguished gentlemen, who were to have been with us to-day, but who for one reason or another have been prevented from doing themselves and us the honor of attending : Consul-General Knapp ; The Lieutenant-Governor of Quebec ; The Hon. Mr. Flynn ; The Hon. Mr. Louis Beaubien ; The Hon. A. R. Angers ; The Hon. Mr. Mackenzie Bowell ; The Hon. Mr. Tupper ; The Hon. Mr. Costigan ; The Hon. Mr. Patterson ; The Hon. Mr. Ives ; The Hon. Mr. Haggart ; The Hon. Mr. Ouimet ; The Hon. Mr. Smith ; The Hon. Mr. Laurier ; Sir A. P. Caron ; Sir Joseph Hickson and Mr. L J. Sergeant of the Grand Trunk Railway.

I have now much pleasure in calling upon Dr. Howe to address you.

DR. HOWE (Boston) — Mr. Chairman, ladies and gentlemen : I firmly believe that an idle man's brain is the devil's workshop. How often has been deplored through Northern New England and Canada the lack of suitable employment for the farmer and his household during the months of winter, when the necessities of the farm do not call for the exercise of much labor. The greatest benefactor to Northern New England would be the man who would bring to the farmer an industry which would occupy the members of his household during the spare and idle time of the year. A long and important step in this direction has been taken by our hospitable young hosts of to-day in teaching the farmer how to mine bog ore, which everywhere in this district surrounds him, and in furnishing him a steady and valuable market, enabling him to use his spare time to advantage, and to utilize a waste product ; transforming a noxious article into a priceless one. For this they deserve the thanks, sympathy and support of the whole community, and for their kindness and unbounded hospitality we all thank them cordially, and wish them God speed in their good work.

DR. R. H. RAYMOND (New York)—Mr. Chairman, ladies and gentlemen : Agriculture and mining are, I would say, two great industries, neither of which can get along alone. We have found out one side of this truth in the United States, where the mining engineer and the mining pioneer have attempted almost in vain, and with unfortunate sacrifices, to put that industry into operation in countries where it was not supported by any other, and where the business of mining had to carry upon its back the load of all the necessities in the life of man.

Here we have an illustration of the opposite side of the same truth, where mining comes to the rescue of agriculture ; as our president has expressed it, by utilizing those forces and also by putting into the very neighborhood of the man who brings forth the products of agriculture, and the man who wishes to use those forces, the wealth of the mines ; and into the hands of each the power to

benefit by them. Thus bringing the producer and the market close together. The progress of science has continually necessitated that one thing should be superceded by another; and yet this is by no means true in a strict sense. If you will allow me the metaphor in this cdince, you will remember how in the history of the Jews the various tribes, the Ammonites, etc., were absolutely annihilated, according to the records of the Testament, in the first chapter; and yet you find them turning up all right in the second chapter. And so we have in many cases of a so-called superseded industry, a survival and revival that is remarkable. We call charcoal iron a deceased business. We say it is played out. But all the while there is more charcoal iron made and more wanted than ever. And while charcoal iron has the properties of charcoal iron, and while the universe retains the laws of the universe, naturally charcoal iron will remain in demand.

I cannot help feeling the great fitness of this scene and this moment, as we are gathered here from different countries and surrounded by the flags we love; and as we out through the windows upon these two great productive industries, seeing around us an evidence of the union of the Church and School—a guarantee, I trust, that learning will here be prosecuted in the fear and love of God, and theology promulgated with some respect for sound reason and education—I say, viewing and feeling this, I cannot help being conscious of how auspicious is the scene upon which the bright skies of to-day bend! I feel, and with a deep sense of gratitude—sometimes so deeply that I cannot put it into words—the privilege and the joy and the glory of having been born at this time and upon this continent! I feel, as I said to the young men of McGill University yesterday, that we have been crowned with the greatest gift ever given to man—the gift of being able to stand by and see an empire grow; to tend its infancy, to join hands with its youth, and to rejoice in the strength of its freedom! And that is your privilege and mine. There never will be, there never can be, anything more glorious than these pioneer beginnings of the greatness of the new age which you and I are privileged to look upon.

MR. A. BLUE (Toronto)—This is not the first time I have have had the pleasure of visiting Radnor Forges. A few months ago it was my privilege to spend a few days here and see the work that was being carried on by the gentlemen who are our hosts to-day. I was then very greatly impressed with the good work they were doing for the community and for the province. I was desirous of knowing what they were doing here, so that we in Ontario might be assisted by trying to do likewise, where we know the value of the iron industry by the want of it. We have been going to school somewhat to our neighbors. We have been attending the meetings of this great institute which has met this year in Montreal, and have been getting inspiration and encouragement from them. I hope the time is not far distant when we will be able to follow in their footsteps, however much behind them we may be. They began the mining and manufacture of iron very early in the settlement of their country. They encouraged the industry then, and continue to encourage it; and it is to-day I think I may say the greatest next to agriculture, which that country possesses. Here in the Province of Quebec, as well as in the Province of Ontario, we find our young men leaving us for want of employment at home. We find them fleeing from their own land. I feel very keenly the situation, and I think a great effort ought to be made to find new fields of employment for our own people, by establishing in various parts of our country industries, such as that here, so that employment may be given; and I trust that the Dominion Government, and the government of each province, will do their utmost to cultivate such industries.

MR. JAS. CRATHERN (of Messrs. Crathern and Caverhill), Montreal, said:—Mr. Chairman, ladies and gentlemen: I observe on reference to the souvenir prepared by Mr. Drummond, that the late Hon. Senator Ferrier worked the property of the Forges over 40 years ago. At that time I was a clerk in his employ, and my duty was partly to superintend the sale of the goods manufactured, which were principally at that time double stoves, coolers—which were often used for sugar purposes—bar iron, &c. The stoves were used entirely throughout the Province of Quebec, and I may say were very efficient articles. That was so long ago, however, that it would be out of place for me to ask any of the ladies present if they remember any of those stoves. If I remember correctly, the first discovery of the value of the ore was made by a company in Troy, actively engaged in the manufacture of railway car wheels. They discovered that the ore made the very best railway wheels, and I believe the gentlemen who are now working this industry are largely engaged in producing the same wheels. I am sure they are to be congratulated very much upon the progress they are making and apparently have made already; and I trust that with the continued aid of the National Policy they may be eminently successful.

The speeches and subsequent applause having terminated, we sought the train again; and after a pleasant run of fifteen miles reached Grandes Piles, situated upon the great and beautiful St. Maurice River.

Here a pleasurable surprise was in store. For no sooner had we alighted than we saw down the road, running parallel with the railway track, a dozen or more improvized open-air busses, to each of which was harnessed a pair of fine, strong, mettlesome horses. gaily caparisoned; and behind each team an expert French-Canadian driver.

Each sleigh was able to accommodate a score, having a framework of light lumber upon a pair of "bobs," with a seat and back on either side, as in pleasure vans.

In we piled, and away we sped down the road and past the bee-hive kilns, that look like so many Esquimalt castles. We go a little sedately at first; but after crossing the river and mounting some tough little hills on the further side, we enter the pine woods where the pure fragrance of the trees and the snow, and the exhilirating influence of the air and the moment make us open our mouths and draw the fresh atmosphere—the tonic of the hills—into our lungs.

Suddenly there is a shout! We know that something has happened; for our jehu with a strong arm pulls up his seventeen hands high horses to a standstill, in a moment, from a furious pace; and we behind him reel and totter and cling to each other as we are thrown off our balance. Looking ahead, we see that one of the loads has suffered a humiliating downfall in its proud career. The three thousand pounds and more of freight has been too much for the framework of the sleigh, for the latter has gone to pieces, and the occupants have been tumbled uncermoniously into the snow on either side, amid the laughter of their friends in the rear. However, no one is hurt. A portion of the unfortunates climb back upon their dismantled craft; and the ladies of the disaster are picked up by and distributed among the procession of sleighs following up in the rear.

So we speed on. We are well into the woods now. Up and down hill and round curves we go with reckless, careless abandon and spirit that is charming. Past the druids of this forest primeval, where not so very many years ago leaped the roe and rang the voice of the huntsman; where crept the wily brave, and whirred from the brown carpet and from beneath the broad branches of almost every pine and fir the prolific partridge.

Ah, what a life these Canadian *habitants* live, we say to ourselves as we feel the glow of animation and health in our veins, and look upward at the "velvet void" where the tops of the swaying pines seem to write "liberty!" What a life they live! And they now it, too, these Canucks! Your Canuck knows when he comes up to the city and sees its pettiness, and insipid pleasures, and lassitude, and need of stimulant, that he has the best of it out here in his woods, with his simple living and his glorious life and health and liberty and strength! Well might he quote:—

"Give me the life beneath an endless sky,
Whose blue afar the darker of the lake
Meets in horizon kisses! Here may I
The echoes of primeval hollows wake;
And in a joyous and exultant cry
My effervescent spirits partly slake,
Nor fear man's pigmy interdict. Here I may be
Like that which is round me—boundless, bold and free!

'Tis some small comfort in this fettered time,
When man within Convention's prison broods,
To feel I am not harnessed to the rhyme
And jingle of her brainless platitudes;
But that in freedom I may boldly climb
With Nature to her most majestic moods:
Scale mountains, stand alone, or eager feel
My pulses answer some swift moving keel!"

The bars of sunshine, that make the forest's carpet a beautiful pattern of white and gold, have grown longer. The air, as it will towards evening, even in a winter forest, has grown stiller. An ineffable peace broods over these hills. But we have been dreaming; for as we start from our reverie,—which, like a certain famous dream, has only lasted a moment—we hear the merry shouts of our companions, the quiet admonition of the driver to Pete or Rosalie; and we see that we are speeding back to the train—and home. And in a little while we are again crossing the St. Maurice River. The solemn woods are left behind us; and with a sigh of regret, we know that the drive is a thing, only to be re-lived again when, perhaps, we sit by a glowing grate on a December evening, retrospective, while Winter raps unheeded at the window pane, and dash over in memory the hills, and between the hemlock and the pines of the wildly magnificent country of Grandes Piles.

But we talk it all over as we discuss our supper with vigorous appetites and smoke our cigars on the run to Montreal. And as we propose the health and prosperity of our hosts and their industry, and of the United Convention of Mining Engineers, we agree with one voice that "the day has well been worth the living."

AN ONTARIO SESSION.

The Necessity of Secure Housing of the Geological Survey's Collection Endorsed—Other Resolutions of Importance Discussed.

On the afternoon of Friday a meeting of the Ontario delegates to the Convention was held in the New Club Room, Windsor Hotel, at three o'clock. A number of outside delegates also joined in the proceedings, and one of their number, Captain Matthew Penhale, manager of the Glasgow and Montreal Asbestos Company, was called to the chair.

PROF. C. GORDON RICHARDSON, (Toronto)—The first resolution upon the official programme, No. 47, namely: "The necessity of enlarged and more secure housing of the magnificent collection of the Geological and Natural History Survey of Canada, at Ottawa," moved by Mr. B. T. A. Bell, was adopted at the meeting of the Quebec Mining Association this morning.

I think that we should all agree unanimously upon the neeessity and value of that resolution. At the present time the collection at Ottawa, while very amply and well displayed, is nevertheless in an extremely insecure condition. That collection represents the combined efforts of the Survey since its inception. Many of the fossil collections, in fact the greater part of the collection, could not be replaced. It would be impossible to replace it. I understand that in the vaults or cellars of the house in which it is stored, are immense stacks of papers, volumes of works of the Survey, and other inflammable material, among which it would only require the careless dropping of a match or tobacco ashes to fire the whole building. And if that happened, "what hope to save the"—collection?

I therefore move, in the absence of Mr. Bell, that we pass this motion.

The motion was carried.

PROF. C. GORDON RICHARDSON moved—"That it would be in the interests of mineral and metallurgical development were a compilation made of all information relating thereto from the time of Sir William Logan's summary of reports in 1863 up to the census of 1890. Also that it would be desirable were the reports of the Geological Survey divided into two volumes, one of which should treat on the Geological work of the Survey and the other on all matters relating to Mineral Occurrences, Mining and Metallurgy. Also that the prices of Geological Survey publications should be reduced to somewhat the same scale as that charged by the Geological Survey of the United States."

He said: I do not think that in moving this resolution I need go into the reasons at any great length for supporting it. Some time ago, I think in 1887, the Canadian Institute, especially the Geological section of it, adopted a resolution of this character and forwarded it under the seal of the Institute to the Canadian Government. At that time the preparations for taking the national census were in progress. It was suggested that it would be well if a complete statistical volume relating to the mining industries and all information appertaining thereto, from the time of Sir William Logan's report of 1863, could be collected and published as a volume of the census of 1890.

For some reason or other, and on account of some antagonism, I believe, between the Statistical Branch and the Survey Branch, nothing material was done. That volume of 1863 is out of print.

It dealt generally with scientific geology, and in another part with economic geology and all occurrences of minerals known up to that time. Since then, although very much information has been collected by the Survey throughout the whole of Canada, that mass of information is scattered through the general volumes of the Survey publication, and is not in a handy form for reference. I have been asked: "What have you done in Canada in reference to mining? Has anything ever been done?" It is perfectly useless for me to refer my questioners to the reports of the Geological Survey, although there is an immense mass of information in regard to our mining industries contained therein.

When the resolution of the Canadian Institute was brought before the House of Commons by Mr. Cockburn, an answer was made to it by the Director of the Geological Survey, Dr. Selwyn, and he took exception to the statement that there was "A gap." He said there was no gap; and he then sent to the then Minister of Interior details of the work done by the officers of the Survey during that time, and also a list of the different papers upon the mining industry, which had appeared up to 1889 since 1863, starting with 1865. Now, sir, there is an immense mass of information scattered through the different publications. What this resolution asked for is that a publication of all that information which has been collected, not only under these heads, but which is also scattered through incidentally what we may term the more scientific papers relating solely to geology, be made and issued as a volume, similar to the volume issued in 1863 up to 1890; from which time annual reports of statistics issued by the division of minerals and mines have been issued. Also, that the volumes of the Survey shall be issued in two separate parts, one dealing with field geology, and the other with the mining and metallurgical industries pure and simple, somewhat similar to Days' report.

MR. GEO. A. SPOTSWOOD (Kingston)—I suggest that they shall be bound in cloth.

PROF. RICHARDSON—That would be very well: but at the present time, if you had, as I have, to write to the department about any information in regard to their volumes, and then be referred to a bookseller, you would think we will be very fortunate if we get what we desire. You are referred to a bookseller; and you are thus taxed not alone the cost of the work, but the bookseller's fees too. You have to pay something like $2.00 or $2.50, while from the U. S. government you would get their report for 50 cents.

MR. A. LEOFRED (Quebec)—How is it we get reports from the Geological Survey about three years after the work has been performed?

(Several members—Hear, hear.)

MR. R. McCONNELL (Sudbury) seconded Prof. Richardson's motion, which was carried.

MR. W. HAMILTON MERRITT (Toronto) moved that it would be in the best interests of the country were the present bonus on iron continued by the Dominion Government, and were the question of provincial bonuses considered favorably by the different Provincial Governments. Also were the question of the manufacturer o

steel rails and of nickel-steel in Canada favorably considered by the Dominion and Provincial Governments.

He said: In my opinion, if the iron and steel industries do not affect the whole of Canada, we have but to say, God help Canada! If Canada cannot and will not deal in a generous spirit with the iron and steel industries, I have little hope for the building up of our country in in modern history. I have a letter here which I will read you, with your kind indulgence, from the seconder of this motion, Mr. E. W. Rathbun, Deseronto, in which he expresses his regret that owing to unforseen events he is unable to be present and give expression to his strong and emphatic views on this matter, which I will attempt, if feebly, to reproduce. (Mr. Rathbun's letter read.)

We in Canada occupy, permit me to say, a very humiliating position in regard to iron and steel. We are beholden, as it were, to the rest of the world, chiefly to the United States and England. This is a matter of serious moment to a country desirous of building herself up and occupying a proud position among the nations. Last year we imported more than twice as much pig iron as was made in the country. We imported $1,700,000 worth or steel rails, which may be considered raw material. Dr. Raymond pointed out this morning that the great civilizing feature of the present day is the Bessemer Converter. There is not one Bessemer Converter in Canada, and we make a very small proportion of the iron consumed in the country, to say nothing of the steel. I should have liked to have pointed out to the Americans their position, as they stood among us here in Canada.

I believe that every citizen of Canada will admit that he would require equally as much iron and steel if he stepped over into the United States, as he does in Canada. And yet he will only have one-fiftieth of what he uses manufactured for him in his own country. Iron and steel manufactures came into this country last year worth about nine and a half, or $10,000,000. Of that the major part came from the United States; $4,800,000 worth from United States, and $4,600,000 from England, showing the enormous amount which we have and which could be filled by home manufacture.

The steel rail question is rather a vexed one. The railroads desire the cheapest steel they can get. The United States dealt with their companies in a statesmanlike manner, in giving grants to their great Pacific railroads. They stipulated that those roads should be built with American steel rails; and that is the policy which should be adopted by the Dominion Government; if not even a still more generous policy. I maintain that the policy which has been adopted has not been a right one, nor in a generous spirit. When people go to war, they do not say: We are going to grant a certain sum of money and if that does not defeat our enemy we will be vanquished. They go into a fight determined to win. Now sir, I contend that should be the policy of this country and of the Government of this country, in regard to the manufacture of iron and steel. Our Government should say: We are going to make our own iron and steel, we are going to make our own rails, and, of course, in our wisdom we will adopt the best and most economic manner in which this policy is going to be carried out. But unfortunately, it appears that a certain Duty was adopted; and it was considered that if that was not a sufficient stimulant, why the industry would have to go to the wall.

Gentlemen, the Government should approach this great national and important question in a broad and generous spirit. They should decide that it is a very momentous matter indeed, a thing of prime importance, that we should manufacture our own iron and steel, and nickel steel also. And if Canada was the first to make a substantial movement in regard to the manufacture of nickel steel, it would help her considerably; because nickel steel will play a great part in the future.

It may be said that we have not the material. But that is a fallacy too absurd to dwell upon; because you are all conversant with the vast quantities of splendid iron ore and coke in Nova Scotia; and with the fact of the great iron fields of New York and New Jersey stretching away into Eastern Ontario, proving beyond a question the great supplies of that ore existing in that part of Canada alone. In Western Ontario the great Minnesota ranges run up into the Port Arthur regions, and through the western part of Canada and in Manitoba. I believe there is no question of valuable supplies of iron; and in British Columbia there is an abundance of iron ore and coking coal in the interior, and which will be of course developed when the country grows.

Therefore, I think that so far as the Dominion Government is concerned, we can very properly appeal to them to deal with this question in a generous manner.

We can point out to them that extreme protection has been necessary by all civilized countries in starting this industry. It was the case with England and Belgium, who now produce more than half a million tons each a year; and with Sweden, who produces nearly half a million tons annually. In view of these facts we can, I say, appeal strongly to the Dominion Government; and it would not be out of place for this Convention to impress upon the Provincial Governments the great importance of this industry.

I may say that I have no personal interest, either direct or indirect, in thus advocating the home manufacture of iron and steel so warmly. I have no interest in any manufactory or smelting works of any kind, nor in any mine. I merely move this resolution, from a purely scientific and metallurgical knowledge of the facts; and feeling as a citizen, and as a Canadian, that we have a great void that can be and should be filled.

Mr. Rathbun who seconds the resolution, on the other hand, gives great force to his adoption of the cause; because he is a man who is ready to put his money into the erection of a furnace. I take it the two forces should be very strong; the desire of the man who has money and is ready to invest that money in a home industry and give labor to men at home; and the desire of the man who is interested in serving the interests and the national greatness of his country.

CAPT. PENHALE—In the United States there is more iron mined and manufactured than in all the rest of the world. In 1890 over 10,000,000 tons of iron were manufactured in the United States. In the United States and in England, in the sense of wealth, Iron is King—And whether we are connected with it directly or indirectly, we all feel the benefit of that industry. Mr. Merritt stated there was not one Bessemer steel plant in Canada. If, as Mr. Merritt, said, investors are ready to put their money into that industry, then I say, make your resolutions and pass them, and get these men to put their money into the building of furnaces. And I tell you, you want furnaces.

Mr. Merritt's motion was carried.

MR. JAS. B. HAMMOND, (Sudbury)—moved "With a view to bringing nickel into more general use, its claims as an economic metal being now fully established, that the attention of the Dominion Government, and the Provincial Legislature be called to the advisability of granting a liberal bonus to the inventor or patentee of a process of refining nickel, which would very materially lessen the cost of production." He said: I have only, for instance, to call attention to the policy of our Dominion Government, with regard to putting on its feet the best sugar industry. I am aware that there are false impressions being circulated with regard to the extent of our nickel country; and in the interest of the whole country, I think we should call particular attention to the fact that not one third of the deposits of a first class character are being worked; and there is an impression going about that certain individuals, having bought up, say 30 to 40 acres a piece, have got a corner on nickel; which we from that part of the country, know to be contrary to the facts.

With regard to nickel as a metal, we have heard what has been said by Mr. Merritt regarding iron, and the disadvantages under which the iron industry has labored. When two industries are weak, why can they not be married so to speak, and hely each other through life. The parents are the Government, and the country. Here are two young industries, and they wish to be united in the bonds of industrial matrimony. In that respect I cordially support Mr. Merritt's motion.

Now, with regard to this motion, in connection with nickel as a separate metal. There is no one who will not agree but there is a vast future for nickel *per se*. The great drawback to the development of that metal industry in Canada has been the cost of refining it. We have it quoted in the market at nearly 50 cents a pound. The great advantages and properties of nickel used in employments of all kinds in connection with wares, cooking utensils, &c., &c., is that it is something which is not attacked by acids. I can see, in view of that, that we would simplify the circulation of the metal ten thousand times over if we could reduce the cost of refining it.

This, then, is a question for the Government to decide, whether they are not losing a great opportunity of engaging the attention of capitalists, or even lending the money and taking the mortgage, as I understand it, to help this young industry on its feet.

This motion particularly calls attention to the fact that we should first reduce the cost of refining, and then comes the consumption. The present processes of refining nickel are chiefly by chemical methods, and are expensive. Whether electricity will solve the question time will tell.

MR. G. MICKLE, (Sudbury)—In seconding Mr. Hammond's motion, I may say that we stand in this position; we have the greatest deposits of nickel in the world; but the consumption is so small that a few companies can supply the demand, and these deposits must be worked. With a view to increasing the consumption, I would support this resolution No one now seems to dispute the value of nickel, not only as an alloy, but as a distinct metal.

I might say, I saw an advertisement by a German nickel firm, stating that nickel was the material of the wares and cooking utensils of the future; that it was not affected by acids; that it never lost its full value as a metal; and offering to buy back all utensils bearing their trade mark.

The only obstacle seems to be the cost of refining, and with a view to the reduction of that cost, I second Mr. Hammond's motion.

PROF. C. GORDON RICHARDSON—There is not the slightest doubt that the market for the nickel itself is practically unlimited. The trouble at present which exists in regard to the nickel industry in Canada is that there is a very high wall erected between the producers of ore and matte, and the market for the fine metal. At the present time I believe I would be within bounds, in saying that the refiners of nickel and copper matte might be numbered on the fingers of one hand. They practically control the price of matte placed upon the market, and the price of refined metal put upon the market. I am not of the opinion, from what little I know of the industry, that there is any special cost in the refining of these mattes. At the present time the average price I think for the nickel in the matte would not be above 13 cents a pound, and the refiners have the difference between 13 cents in the matte and, we will say, 40 or 45 cents in the refined metal. I think that this is an immense margin for refiners, and our industry is seriously hampered. I have a letter from Dr. Peters, stating that any company which entered upon the production of nickel matte without being prepared to refine that matte had his hearty sympathies: and therefore I am very pleased to give my support to the motion of Mr. Hammond.

CAPT. PENHALE—Would it not be a good thing for the Dominion Government to pay a man efficient in the business to go over to England and drum up the matter among the capitalists, and tell them what you have in Canada, and what a field there is for their money? In London the money is locked up; they are waiting to invest it. It seems to me that if the Government would spend $5,000 in that way it would do more good than all the immigration schemes they ever concocted.

MR. Hammond's motion was carried.

MR. G. A. SPOTSWOOD, Kingston, moved "That it would be in the best interests of the country if it should be made compulsory by the Government that railways to be built receiving a Government bonus should be railed and bridged with Canadian iron and steel."

MR. HAMMOND seconded the motion which was carried.

MR. G. McKAY (Sault Ste. Marie), in the absence of Mr. Thomas Ledyard, Toronto, moved "That it would be in the best interest of metallurgical developments were all fuel used in the smelting and refining of ores and metallurgical products allowed to enter duty free into Canada."

MR. SPOTSWOOD seconded the motion, which after some further discussion was carried.

The meeting adjourned at 5.30 p.m.

McGill Mining Society.

A few years ago the number of students in the mining department of McGill College, Montreal, was so small that it was thought advisable by many to discontinue the teaching of this branch of science. Sir Wm. Dawson and Dr. Harrington opposed this, pointing out that graduates in mining had been far more successful than those of any other department, and it was therefore decided to continue the course. Mr. W. A. Carlyle, Ma. E., a graduate of McGill, was brought back from Colorado as lecturer in mining and metallurgy, and from that time the course started out on a fresh career.

This year there were 25 students in mining, and it was thought that much benefit could be derived from meeting for the purpose of discussing subjects relating to mining.

With this object in view the "McGill Mining Society" was formed last December. The officers were: B. J. Harrington, B.A., Ph. D., *Hon. President*; W. A. Carlyle, Ma. E., *President*; H. Herdt, Sc. '93, *Vice-President*; A. A. Cole, B.A., Sc. '94, *Sec'y-Treasurer*. *Committee*: J. H. Featherstone, Sc. '93; R. A. Gunn, Sc. '94; O. C. Hart, Sc. '95; H. H. Barclay, Sc. '96.

Five meetings were held during the session, and they were very well attended by the students, the subjects being as follows:

1st. The Duties of a Mining Engineer, by Mr. W. A. Carlyle; 2nd. Life Underground, by Dr. Harrington; 3rd. A Debate:—"Resolved that Bi-metallism should be adopted by the nations." Affirmative, J. H. Featherstone, A. A. Cole, B.A. Negative, H. Herdt, R. A. Gunn.

This meeting proved very entertaining and instructive. At the close of the debate a vote of the meeting was taken on the merits of the speeches, which resulted in a victory for the affirmative. At the 4th meeting Capt. R. C. Adams gave a paper on 'Mica and Phosphate' and at the 5th a paper was given by Mr. T. Brown on 'Rock Drills and Air Compressors.'

This being the last meeting of the session refreshments were supplied and farewell speeches were given by the members of the graduating class.

On March 4th, the Society held an excursion to St. Henri to examine the works of the Ingersoll Rock Drill Company. Mr. Gilman, the manager, had a compressor and drill running for the benefit of those who had not seen these working before; and he kindly gave up his afternoon to explaining to the students the mechanism of the drills and compressors in construction.

The students have been asked to take note of any points of interest connected with mining that may come under their notice during their summer work, so as to give the Society the benefit of their observation next winter.

A bright future for the Society may be anticipated if we may judge by the enthusiasm shown this year; and the more sanguine prophesy that before very long the most flourishing society in the University will be the "McGill Mining Society."

The Duty on Mining Machinery.

A deputation from the General Mining Association of the Province of Quebec had an interview with the Hon. Clarke Wallace, Comptroller of Customs, on Wednesday, 9th March, on the subject of a more liberal interpretation of the law respecting the admission of free mining machinery. The Comptroller evinced great interest in the various points brought forward by the delegates, and promised that they should have his careful consideration. Difficulty being experienced by the collectors in discriminating between what class and kinds of machinery were made and those which had to be imported, it was agreed o submit a statement for reference to the Department.

THE NEXT QUARTERLY GENERAL MEETING OF THE

General Mining Association of the Province of Quebec

WILL BE HELD ON

FRIDAY, 7TH APRIL, 1893,

IN THE

NEW CLUB ROOM, WINDSOR HOTEL, MONTREAL,

COMMENCING AT TEN A.M.

MORNING SESSION.

Report of Committee on Amendments to Constitution and By-Laws.

The Duty on Mining Machinery.

Report of Deputations, etc.

AFTERNOON SESSION.

COMMENCING AT TWO P.M.

Mica: Its Occurrence, Composition, Development and Uses.

A series of papers by C. CIRCKEL, M.E., East Templeton, Que.; S. P. FRANCHOT, Villeneuve Mica Mine, Buckingham; DON C. WATTERS, Lake Girard Mica Mining System, Ottawa; PROF. B. J. HARRINGTON, Montreal; and B. T. A. BELL, Secretary.

Peat: Its Occurrence in Quebec, and Utility as a Fuel for Industrial and Domestic Consumption.

By DR. R. W. ELLS, Ottawa; MR. GIBSON, Bureau of Mines, Toronto; J. MCDOUGALL, St. Hyacinthe, Que.

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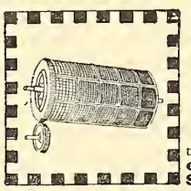

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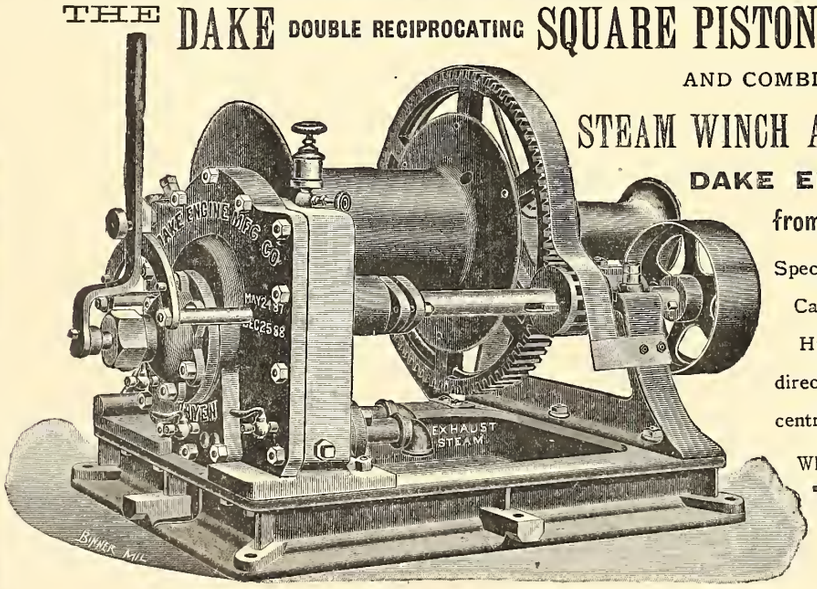

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Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

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Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. &. Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

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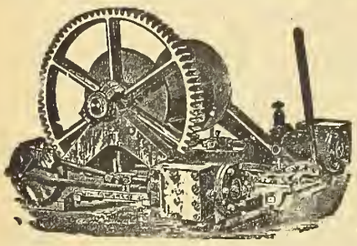

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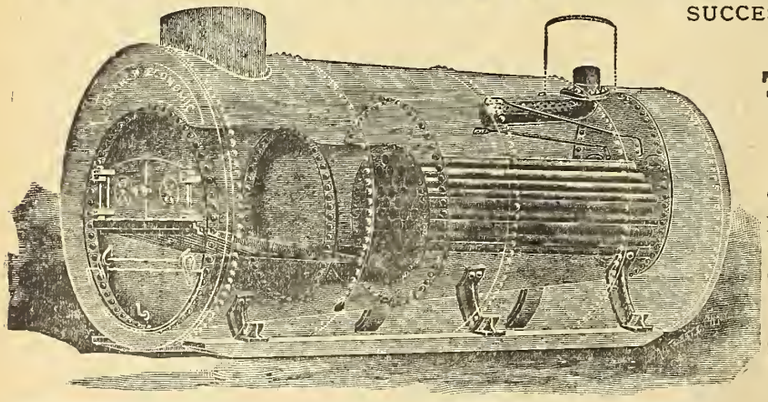

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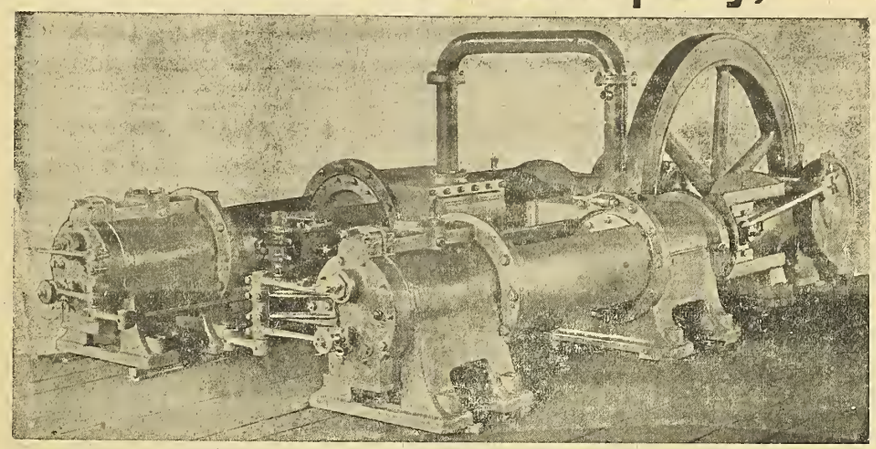

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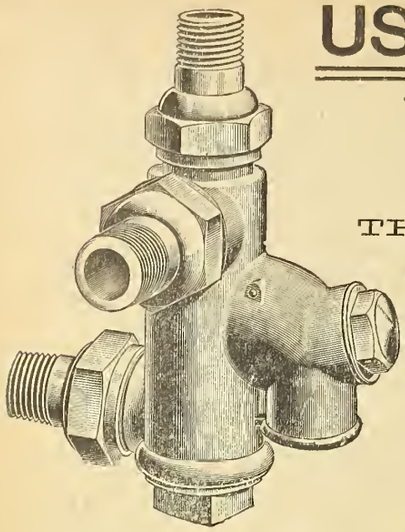

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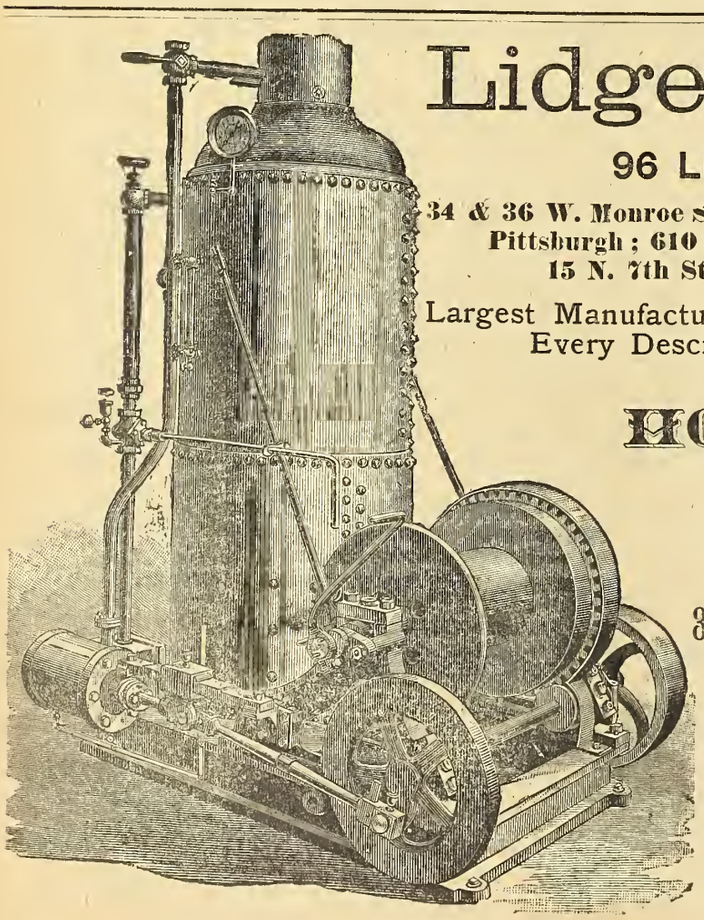

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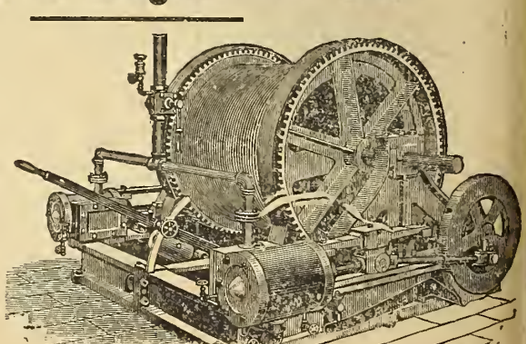

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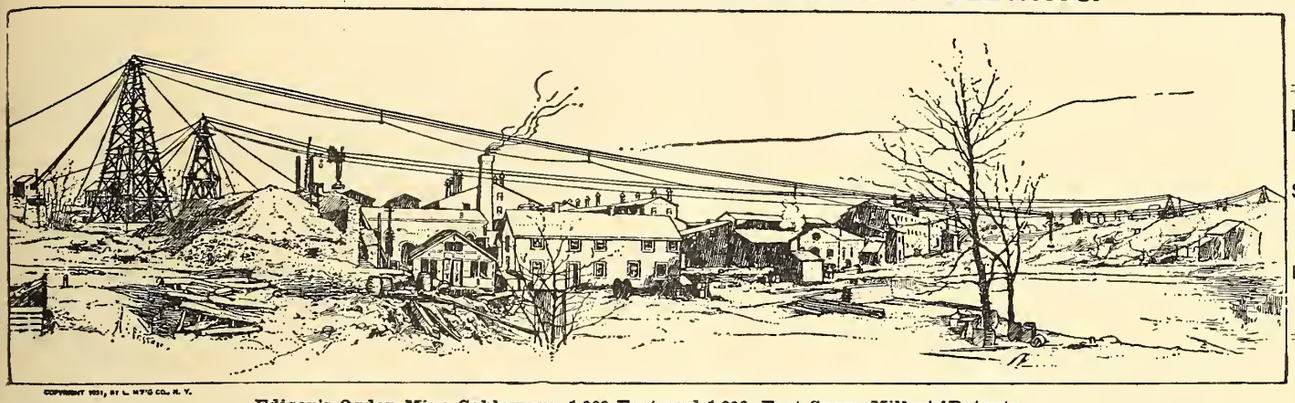

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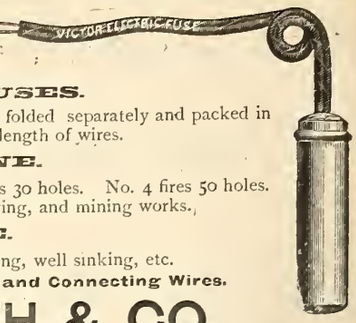

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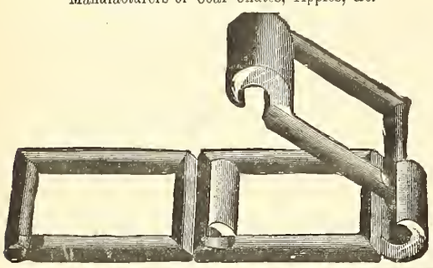

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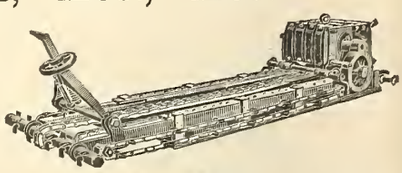

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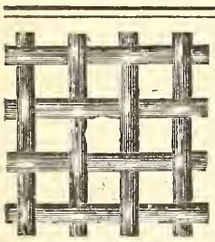

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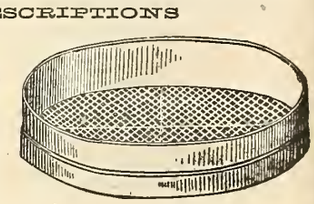

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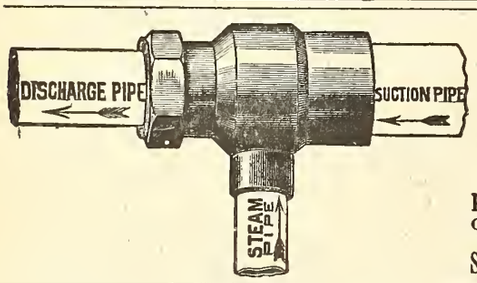

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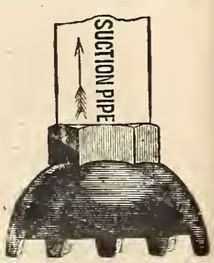

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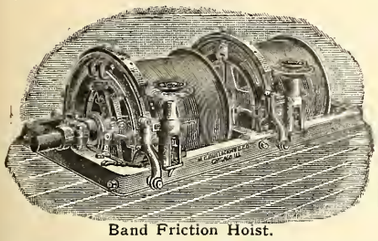

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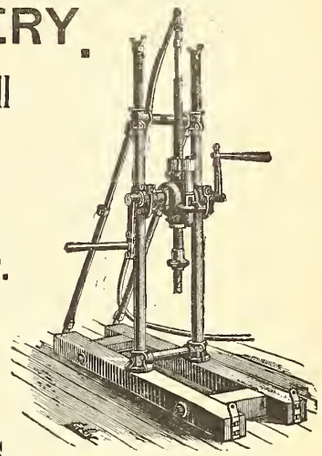

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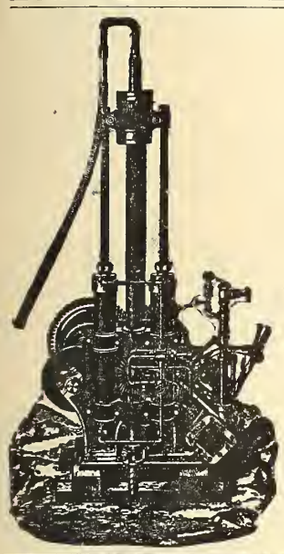

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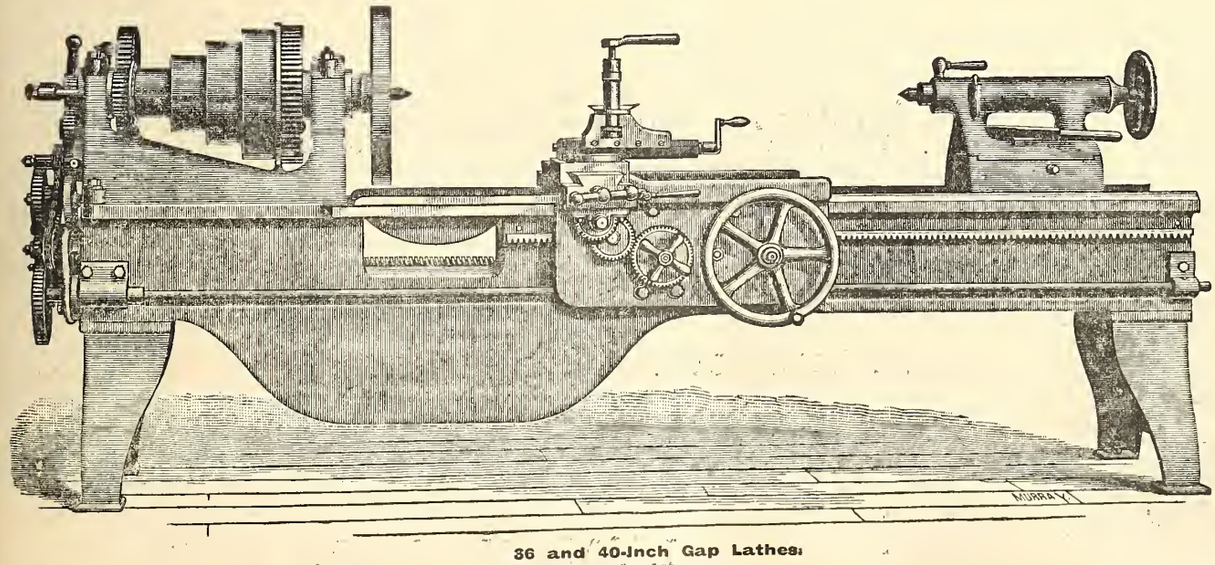

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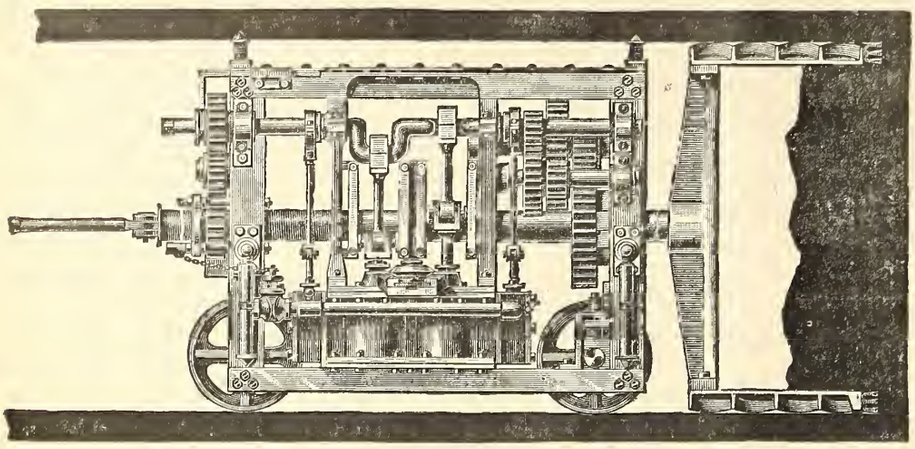

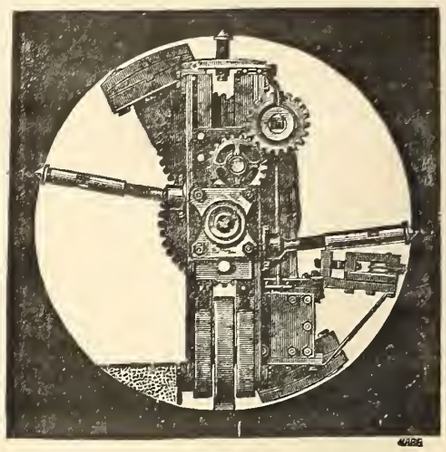

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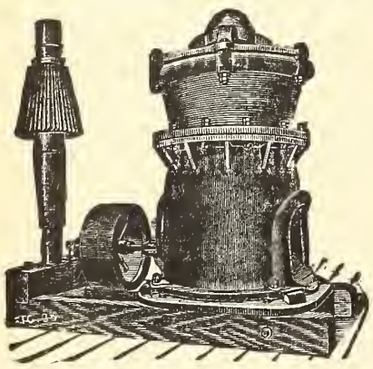

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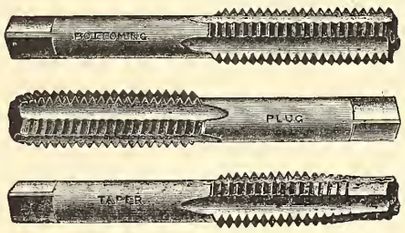

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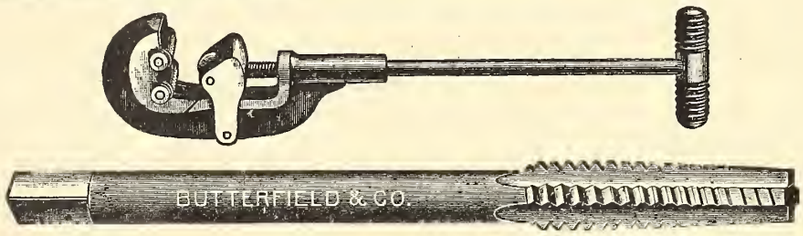

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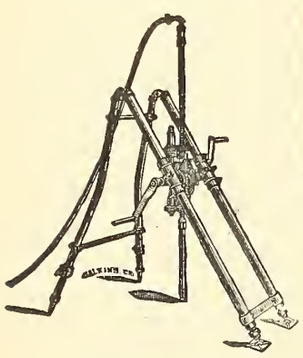

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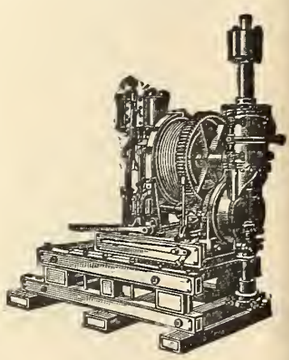

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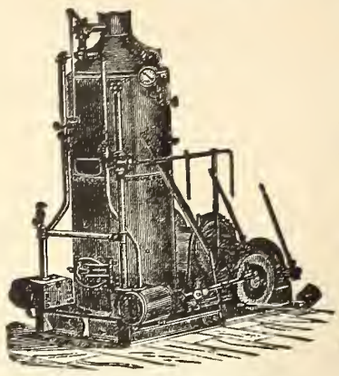

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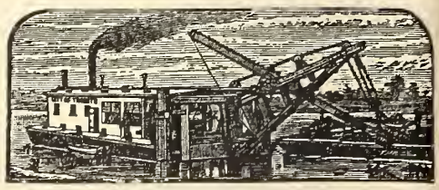

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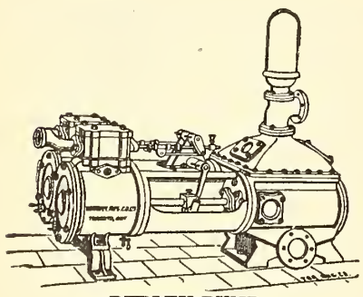

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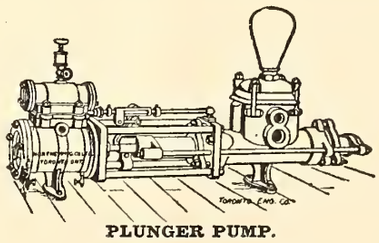

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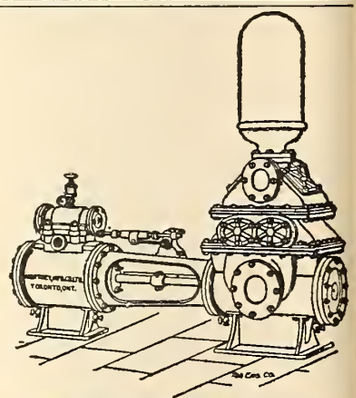

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Vol. XII. APRIL, 1893. No. 4.

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THE UNITED MINING SOCIETY OF NOVA SCOTIA,

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THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The Cape Breton Coal Syndicate.

Now that the political smoke which shrouded the birth of the Dominion Coal Company has begun to clear away, the general public may be interested in learning the plans of the promoters so far as they have been matured. Their scope may be most graphically understood by devoting a few lines to the state of affairs existing in the territory they have acquired. The General Mining Association having acquired the grant of all the ungranted mines and minerals in the Province of Nova Scotia, found on their arrival here that the best mines in Cape Breton and Pictou Counties were already granted and being worked. They acquired all the outstanding rights in these worked mines and inaugurated a monopoly. This was a veritable true blue monopoly, but at the same time a bonanza to the Nova Scotians. Wood was abundant, and coal in little demand, except at Halifax and in a few villages; but the large amount of money circulated by the Company gave employment to many workmen. The agitation which finally resulted in the cessation of the monopoly on terms mutually advantageous to the province and the Company, was partly personal, partly political, and largely that of the boomster. Upon the opening of the coal fields to the general public, a crowd of speculators rushed in and numerous mines were opened. The benefits which were promised from the breaking down of the barriers were however not realized with satisfactory promptitude. The sales of the General Mining Association in 1858, were 226,725 tons, and ten years later the added production of all the new mines made the total sales only 453,624 tons, and this during the years of free trade with the United States.

The rivalry which characterised the new companies in Cape Breton, inflicted heavy burdens, which some of them have carried to the present day. In Cow Bay were two expensive piers side by side. Two rival ports in Glace Bay. Two parallel railways from Glace Bay to Sydney, each with an independent pier, and so on. The poorer mines instead of being able to utilize the facilities of their wealthier neighbors, had to load vessels from scows, or to build wharves the sport of each succeeding winter. This competition existed outside the mines, and agents sacrificed coal, while an observant public laughed and got its fuel cheaply. The amount of money this competition has cost the Cape Breton mines runs into millions of dollars.

It is little wonder then that the shareholders of companies, representing without exception the most favored coal deposits of the continent of America, have been ready to retire from the barren honors of a system of fruitless competition.

It may be said here in justice to the shareholders of these companies that it is doubtful if they ever had clearly laid before them the benefits of a more or less complete consolidation of some of their operations, such as the management, transportation, sale, etc., of their product, or they would have taken some steps looking to reduction of costs, etc.

From a consideration of these very brief notes it will be apparent that so far as regards the mining operations, the Dominion Coal Company by consolidating these mines is fairly entitled to such profit as may accrue from regular and systematic system of mining, transportation, cet. In other parts of the world it is no uncommon thing to see a single company raising and selling annually a coal tonnage far in excess of what can be got from the Sydney coal field for some years to come. The abolition of the isolated staffs of managers, clerks, mechanical foremen, shipping agents, brokers, etc., attached to each colliery, and their replacement by a central source of control and supervision is alone no small item. The concentration of the transportation and shipment upon one peir in Sydney Harbor, provided with ample storage capacity to meet the gulf and local trade is a prerequisite. The continuation of such system of transportation to Louisburg will provide what has long been desired, a winter outlet. The importance of this is evident when the shipping season under the present trade conditions is scarcely seven months. Those who have had to struggle during a long winter in Cape Breton with the expense of keeping men and horses doing next to nothing, and maintaining pits in order, pumping, ventilating, etc., could best tell what a boon anything approaching steady work would prove.

The most noticeable point in this connection is the fact that the facilities for transporting coal by sea from the Cape Breton mines have unavoidably lagged behind the times. Steam transportation for the Gulf trade is imperative for many well known reasons, but the Cape Breton mines have hitherto been unable to fit themselves out properly for this important part of their business. Clearly no company hitherto operating in this field has had the resources to build proper coal-carrying steamers, consequently they have been obliged to employ a class of vessels, not the best suited for their peculiar requirements.

The new company should be provided with steamers adapted for speedy loading and unloading, capable of carrying large cargoes, and strong enough to tow one or more coal barges. In the case of the Gulf trade this will necessitate proper terminal facilities at Montreal, and an improvement upon the facilities at present provided at the other principal points of sale in the Gulf. These improvements in unloading steamers and loading cars, must be coupled with such lengthening of locks, etc., as will allow of coal carrying barges being taken west of Montreal. The difference in cost between the present system of transportation, and a business system such as is here outlined would astonish many people, and be equivalent to a carrying of Nova Scotia coal many miles west of any point reached by it at present.

Similar remarks apply to the transportation of coal from Louisburg to the United States, and there is no reason forbidding the construction of steamers carrying 8,000 tons per trip, and strong enough to take half as much more in tows. This leads to a largely increased output of the mines acquired by the Dominion Coal Company.

The present workings will require new arrangements and fresh machinery to enable them to greatly increase their output, and one or two new pits will have to be provided capable of delivering a couple of thousand tons each a day. The outlook therefore for the future in Cape Breton is decidedly encouraging; it is however likely that the coal trade of Cumberland and Pictou with Montreal will suffer at the hands of the new syndicate.

The success of this company in getting afloat, has incited a number of imitative schemes which have applied to the Local Legislature for Charters. Among them may be mentioned the Standard Coal Company, reported to be interested in coal areas in Port Hood, the Consolidated to operate in Cumberland county, and the Boston and Nova Scotia to operate at Broad Cove. The latter proposes to build a railway from Broad Cove to Orangedale on the Cape Breton Railway and to ship at the Strait of Canso or the mouth of the Inhabitants River. The cost of transportation of coal will somewhat

handicap the opertions, and the returns of the railway, some thirty miles long, from general traffic, will, judging from railway experience in Cape Breton during the past two years, not go far toward paying expenses.

Nickel Metallurgy.

Perhaps the most exhaustive as well as comprehensive and eminently practical treatise on Nickel and the progress in the metallurgy of this rare and precious metal, is to be found in a memoir recently published by a celebrated French engineer, Mons. David Levat, late Director General of the Society "Le Nickel," of Paris, France. This publication contains nearly one hundred pages of a report giving the mode of occurrence and methods of extracting the ore, and its roasting for the matte. It deals with the ores of nickel found in New Caledonia and in Canada. The first chapter has special reference to the New Caledonia ores; their origin, cost and mode of working, cobbing and washing; output of the quarries; transportation; treatment; fusion; reduction in Europe; and sums up also the ores of Canada, in the Sudbury district, giving their exact situation, mode of occurrence, composition and nature; poor outcrops; extraction of the ore in blocks as if from quarry; rich finds; underground work; transportation; calculations as to the revenue, etc.; roasting, the V method so-called; the fusion of roasted ores and the Herreshoff oven; the consumption of the metal; cost and revenue from reducing, etc.

The second chapter deals essentially with the metal as an alloy. Its reduction is discussed by the *dry method* and the separation of the iron; reduction in the reverbatory furnace and reducing furnace; also with the direct refining of the pigs. Then the chapter goes on to discuss the roasting of the reduced matte; the moulding and drying process in the oxyde of the ore; reduction in crucibles; in 'moufles'; in gas producing ovens; then the polishing-off process and the mercantile product itself.

Then there is a description of the *wet process*, the separating of the copper and the application of electrolytic reagents. The methods carried on at the works of Saint Denis. Impurities in the nickel often result from the wet method; these are also discussed whilst the Herrenschmidt process is described.

The third chapter deals with the metal in its pure state and the process of fusion for lamination. Properties of the metal are then discussed, how it can be tempered, nickel plating on iron, nickeling, polished nickel and flowing nickel. after which the Powell process is noted together with other new methods of treating nickel.

Then comes perhaps one of the most interesting sections of the report bearing on the alloys of nickel.

The first nickel alloy or combination of nickel with some other metal which M. Levat presents is nickel with copper—in which there is given a classified list of the various combinations of these two metals producing good results.

How Maillechort, Silverine, Argentan and other alloys are manufactured, their lamination and subsequent firing. The binary alloy (20 p.c. of nickel and 80 p.c. of copper) of copper and nickel is the one which is being adopted all over Europe for their new armour plates. The various properties of this alloy, offering enormous resistance and high tenacity, are noted, whilst the coefficient ductibility remains very high.

The manufacture of hearths for locomotives, of covers, nickel coins, French coins, coins from Mexico also receive a goodly share of notice.

The alliance or combination of nickel with iron and steel comes next. Their application in the case of plates for cruisers; experiments at Annapolis; experiments at Indian Head; the properties of nickel steel; the Mercadier method, and illustrations by Mr. J. Ritez are given and followed by experiments in traction, torsim, etc. The non-oxidizing influences and characters of these alloys is followed up by the available statistics on the output and production of nickel giving also the price of that metal, which is fast becoming so useful in the affairs of every day life throughout the world

Iron Mining in Ontario.

The man who attempts to write about iron mining in Ontario emulates that distinguished historian whose chapter on the snakes of Ireland consisted of the words, "there are no snakes in Ireland." Whether this statement holds true at the present time when there is a prospect of wigs on the green in the Emerald Isle, may be left to the friends of Mr. Gladstone's Home Rule Bill—or its enemies. But neither of these classes nor any other would deny the truth of the allegation that there is no iron mining in Ontario. The iron mines in this province may or may not rival Solomon's temple of old in point of richness, but they certainly resemble that edifice in the fact that they are strangers to any sound of hammer or tool. The stagnation is complete. There once was a fair amount of activity in the iron districts of Ontario when ore was raised and shipped to the United States markets, but the glowing prophecies made twenty-five or thirty years ago of the probable expansion of the iron mining business in this province contrast strongly with the pitiful performances of to-day. A collapse as complete as that which befel the workers on the tower of Babel has overtaken our iron mines, no one under existing conditions ventures to predict a genuine resumption of activity in any thing like the near future. Owners of caved-in shafts and holes in the ground filled with water may find some satisfaction in knowing that the ore is still on their property and that when the turn of the tide comes their long-deferred hopes of prosperity may stand some chance of fulfilment, but it is hard to live in hope, and to grow fat on it is simply impossible.

What is the cause of this state of affairs? Why is it that with abundant supplies of iron ore, ranging in quality from bad to best, but with plenty and to spare of all grades, with a population growing in wealth, increasing in output of manufactures and advancing in all departments of industrial activity, there was not a single ton of iron raised in Ontario last year? Why is it that there are no blast furnaces in the province? We have endless supplies of ore, mountains of limestone and forests of wood, yet every pound of iron that goes into the steam engines, agricultural implements, mill machinery and the thousand and one products of our foundries and machine shops is smelted beyond the boundaries of Ontario, and not one pound of it is from Ontario ore. We talk of the progress we are making in the arts of civilization and peace, but if our production of pig iron or even of iron ore be taken as the standard of judgment, we shall have to hide our diminished heads in shame. In the vast development which has characterized the business of iron manufacture in the United States, Great Britain and most other civilized countries during the closing half of the nineteenth century, it must be confessed that we have had but little share, and so far as the smelting of the ore itself is concerned, we have had no share at all. We have been content to refine the pig and re-melt the scrap of other lands, but have done nothing to add to the world's stock of the metal. We have not been backward in adopting the improvements and inventions which have been made in the domain of machinery and iron manufacturing generally, but so far as actual production of the metal itself is concerned, while the civilized world has been living in the iron age, we have been living in the stone age.

Comparing ourselves with our neighbors, we find that we are far outstripped by our co-partners in the Confederation, small even as the total production of iron and iron ore in the Dominion is. Quebec in 1892 raised 28,090 net tons of ore and smelted into pig 36,540 tons, while Nova Scotia raised 75,000 tons; Ontario neither raised nor smelted any. In 1891 the total production in the Dominion of iron was 23,891 (net) tons, and of iron ore 68,979 tons, of which quantity Ontario contributed as her share a total of some 200 tons of iron ore. Contrast this with the 5,856,169 (long) tons of iron ore raised in Michigan in 1890, or the 6,127,101 tons mined there in 1891! The progress made in the iron mining industry in the State of Michigan is in truth something phenomenal, even in these days when advances in trade and commerce are made by leaps and bounds. In 1850, when Ontario was beginning to congratulate herself on the bright prospects ahead of her iron mines, the production of Michigan was only only 2,700 tons of ore, in 1891 it had risen, as stated above, to the enormous figure of 6,127,101 tons, while that of Ontario had dwindled to an amount scarcely visible to the naked eye. The marvellous development in the production of the iron mines of Lake Superior, in Michigan, Wisconsin and Minnesota, during the last ten

years may be seen on perusal of the following figures: in 1883 it was 2,352,840 (long) tons, in 1886, 3,559,371 tons; in 1889, 7,292,644 tons, and in 1892, 9,074,243 tons. In last year's production was included 4,245 tons from the Mesaba range in Minnesota, a new source of supply just beginning to be opened up, which promises to be as prolific as the Marquette, Menominee, Gogebic, or any of the older ranges. There is at present one mine, the Norrie, situated on the Gogebic range in Michigan, which is producing iron ore at the rate of about 1,000,000 tons per annum. Alabama increased her output of ore from 171,139 tons in 1880 to 1,570,319 tons in 1890, and 1,986,830 tons in 1891. Wisconsin produced 37,000 tons in 1880, and in 1890 the production had risen to 837,399 tons. Tennessee in 1880 produced 93,272 tons; in 1890, 473,294 tons, and in 1891, 543,923 tons. Pennsylvania, New York, New Jersey and other States, have long been heavy producers of iron ore, but the States named above have all (with the exception of Tennessee), begun the mining of iron ore in appreciable quantity at a date subsequent to the beginning of the business in Ontario, and all have left her hopelessly behind in the race. Alabama, which in 1872 produced 11,171 (long) tons of pig iron, in 1892 smelted 915,296 tons; Michigan in 1872 made 89,484 tons, and in 1892, 148,421 tons; Tennessee in 1872, 37,905 tons, and in 1892, 300,081 tons; and Wisconsin, in 1872, 58,092 tons, and in 1892, 114,961 tons. The total production of iron ore in the United States in 1890 was 14,518,857 tons, and of pig iron 9,202,702 tons, the latter in 1892 being a trifle less, viz., 9,157,000 tons. But further statistics of this sort are unnecessary. They but help to bring more unmistakably into notice the fact that while other portions of the North American continent have been making constant and very rapid progress in iron mining and iron making, here in the favored Province of Ontario in the year of grace 1892 we are forced to confess that not only is no progress being made, but that we are actually retrograding.

The courses which have led to this unsatisfactory condition of things are perhaps less important to know than the means to be adopted to remedy it, yet the latter can only be intelligently applied when the former are understood. No one who considers the situation with an unbiassed mind can do otherwise than come to the conclusion that in whatever way freer trade relations with the remainder of this continent would affect other industries and interests in Ontario it could have none but beneficial results upon iron mining. The close competition which the opening up of the new sources of supply within the past few years has given rise to in the United States markets has made it impossible to raise iron ore and ship it across the lines in face of a duty of 75 cents per ton, and the result is that the iron mines of central and eastern Ontario within easy distance of the great smelting centres in Ohio and Pennsylvania have been forced not only to cease raising ore to the surface but have even in some cases been obliged to keep on hand considerable quantities which had accumulated at the mouth of the mines when last in operation. Were commerce as free between Ontario and the United States as it is between Michigan and the rest of the Union, it is surely reasonable to suppose that results would ensure in Ontario similar to those which have followed in Michigan. Not only could iron ore be exported, which in itself would be a very great boon, but with a large outlet for charcoal iron, for the production of which the facilities possessed by Ontario are unequalled, the business of smelting would receive an impetus which could not be imparted to it in any other way. The Report of the Commission on the Mineral Resources of Ontorio (1890) sums up this aspect of the situation very concisely in the following words: "The beneficial influence to be exerted upon the interests of the province by the stimulating effect certain to be the result of the breaking down of hostile tariffs between Canada and the United States would in the case of the export of iron ore, and probably of pig iron also, be certain to promote the prosperity of Ontario to an extent greater than any but the most sanguine would venture to predict."

But exporting iron ore to the United States against a duty of seventy-five cents a ton is an impossibility, and any trade re-arrangements with that country which would admit our ore free or at a low tariff are apparently doomed to remain in the clouds for some time yet. Is the iron business, then, to continue in its present state of deadly dullness, or is it out of the range of possibility to adopt some means within our own command to infuse life into it? Exporting iron ore being out of the question, obviously the only way in which a market for it can be provided is by establishing furnaces within the Province to smelt the ore at home. We have a population of over two millions which is a steady and large consumer of iron for all sorts of purposes, and the annual consumption will inevitably increase with the increase in our population. Nor is there anything which would tend more to the prosperity of the country, the development of its resources, or the general building up of its industries than the establishment of a healthy and successful business in the production of pig iron. All the labor employed in foreign countries in the mining of the ore, in taking it to market, in handling and smelting it at the furnace, is paid for in Canadian money when the pig iron is brought to the borders of our Province, and it takes the place of an equal amount of labor which might be employed at home were the iron produced here.

Up to the present time our energies as a people have been mainly directed to the development of agriculture, and the policy of our Provincial Government has been steadily directed to the encouragement of farming in every possible way. An agricultural college has been established and maintained at large expense, dairymen's and fruitgrowers' associations have received annually subventions from the Provincial treasury, travelling dairies perambulate the country at public expense teaching the youths and maidens of the land to make good butter instead of a corresponding quantity of axle grease, every township fair draws from the chest a grant to swell its prize list for fat pigs and log-cabin quilts, and no one grumbles at the cost. But surely agriculture is not everything. The miner draws the raw material from the bosom of mother earth and converts it to forms suitable for man's use just as truly as the farmer does, and his operations are attended as a rule with very much more expense and risk. On the other hand when his business is conducted in a large way the miner affords employment to labor on a scale with which the farmer, no matter how many acres he may work, cannot compare, and around his mine and furnaces there springs up a market of the very best kind for everything the farmer can produce. Every one knows that there is no better market for farm produce than a mining town. The honest farmer has been a favored guest at the Government table for, lo! these many years, and it would now seem in order if his mining brother were to get a share of the favors which have hitherto fallen almost exclusively to the agriculturist's lot.

There are indications, both many and strong, that the present time is an auspicious moment for the government of Ontario to reach out a helping hand to the iron industry. The conviction has become general that it is little short of a disgrace to the Province that she should be dependent upon foreign countries for her supply of iron when the raw material exists in such profusion within her own limits, and public spirited citizens ask what is better calculated to check the exodus and keep our young men at home than providing the means of employment which the mining, hauling, handling and smelting of iron ore would afford, to say nothing of the many related industries that would be its natural outgrowth. Smelting works once in operation would give a market for ores, and would naturally be followed by rolling mills, foundries, car wheel works, etc., to utilize and work up the pig iron produced. What has helped to build up Pittsburgh, Detroit, Cleveland, Buffalo, and many other cities across the line? Have these places not grown largely because they have become the seat of a thriving business in handling and smelting iron ore and pig iron? It is true that there is a much larger market across the line to absorb the output of the furnaces situated in these cities and elsewhere, but is there any reason to suppose that like results would not follow the establishing of furnaces here to supply our Ontario market? The Dominion government have placed a protective duty of $4 per ton on pig iron, and have added a bonus of $2 per ton on pig produced in the Dominion, now let the Ontario government grant some substantial assistance, and there can be little doubt that smelting furnaces will quickly rear their stacks in our province. Practical men and capitalists stand ready to risk their means in the venture if they can be assured of the government's en-

couragement and aid, either in the form of a bonus of say $2 per ton, the grant of an area of wooded land for charcoal purposes, the giving of a lump sum of money, or some such way. A bonus of so much per ton of output for a certain number of years would probably be the most suitable and satisfactory method of assistance, and it might be hoped that at the expiration of the term the business would have secured such a hold as to be able to stand alone.

There is another reason why the government may fairly be expected to come to the aid of the mining industry. By the new mining Act the government formally abandoned the policy of granting the minerals *in toto*, and now reserves a certain percentage of their value in the form of a royalty on the output. In this way the government practically declares itself a partner in all the mining ventures of the country, and it is contrary to all rules of partnership that the expense and risk should be wholly on one side. If a company is formed to work one or more of our neglected iron mines and to furnish the capital to establish and carry on blast furnaces, in view of the position assumed by the government in the new mining Act, and the immense public benefits which would flow from the erection of such works, it does not seem unreasonable that the public treasury should be called on to lend a helping hand.

Opinions may differ as to the respective advantages of coke and charcoal as fuel for furnaces in Ontario. In the United States by far the largest proportion of the output of pig iron is smelted by means of coke, the figures in 1892 being 75.2 per cent. coke iron, 18.97 per cent. anthracite iron, and 5.83 per cent. charcoal iron. While the actual quantity of charcoal iron produced in the United States does not now vary greatly from year to year (1892 the production was 532,365 tons) the increase has of late years been almost wholly in iron smelted by coke, so that the percentage of charcoal iron to the total output is much smaller now than formerly. The preference given to coke and coal by United States smelters is easily explained by the abundance of coal and the comparative and growing scarcity of wood suitable for making charcoal. In Ontario, however, a different state of things prevails. Here we have no coal and would require to import all our coke for smelting purposes, while in the immediate neighborhood of many of our ore deposits and within easy reach of almost any suitable site for a furnace are great stretches of land covered with wood adapted for making the best of charcoal. The cutting of this wood, the hauling of it to the kilns and the burning of it into charcoal would give employment to a large number of men and in this way the use of charcoal for smelting would ensure the expenditure of every dollar of money laid out for fuel among our farmers and backwoodsmen, instead of sending it to the States to purchase the product of the ovens and labor of Connellsville. This is a consideration which in granting assistance the Government would do well not to overlook, and it might be well to stipulate that the fuel used should be charcoal produced in our own province. There is also the advantage that charcoal iron brings a higher price than coke iron, and can be used in the manufacture of car-wheels and malleable castings, or wherever toughness and strength are essential, to great advantage. If charcoal furnaces were decided on, it would be necessary to erect them in proximity to supplies of wood as well as of ore in order to save haulage. There are localities in the iron districts of both eastern and western Ontario where wood and iron ore are found in large quantities close to each other, and in such places there will be no difficulty in finding good sites for all the furnaces likely to be put up. It would perhaps be found that a grant of land covered with hardwood would also be a very practical way of aiding in the erection of a charcoal iron furnace. In the Port Arthur district, again, there is an abundance of wood which, though not equal to the hard varieties, is yet capable of yielding a charcoal quite fit for the purpose of smelting iron, while the pig iron could be carried by water to many points at which it might be used, a consideration worth taking account of. On the other hand if it were determined that coke should be the fuel used, one obvious advantage would be to place the furnaces in such a position that while close enough to the supplies of ore they should not be obliged to pay unnecessary freight upon the coke. In this case possibly Toronto, Hamilton or Kingston might with advantage be selected as the site of the furnace or furnaces.

There need be no dubiety as to the quantity and quality of our Ontario ores. The hard magnetic ore which perhaps forms the bulk of the deposits of eastern Ontario, is similar in many respects to the magnetite from which the Swedes make the best charcoal iron in the world. There are enormous bodies of it, many of them contiguous to railway communication, which in some cases has been built largely for the purpose of promoting their development, and the means of transporting the ore already exist waiting to be taken advantage of. The excellent quality of many of these deposits has been proven by shipments made to the furnaces of the United States, and there is sufficient diversity in the nature and texture of the ores to give the mixtures desirable for many purposes in the furnace. Quantities of hematite are also known to exist, and more would probably be discovered were there a demand for this ore, as there doubtless would be in the event of furnaces being established.

The aid given to the iron industry should take a well defined form and should be guaranteed for a specified term of years. The investments which have hitherto been made in blast furnaces in Ontario have almost invariably resulted in total loss, and the record of failures is so unbroken that capitalists have apparently almost reached the conclusion that an adverse fate pursues the industry with relentless rigor. But if the history of the business be inquired into, it will be found that in the majority of cases iron smelting has been tried here by inexperienced men or men without the necessary means. Every mining district in America can show a list of failures perhaps as great as the iron sections of this province, yet the mistakes and misfortunes of pioneers have been the stepping stones on which their successors have risen to prosperity. The timidity of capital is proverbial, but with the natural advantages afforded by Ontario for the manufacture of pig iron reinforced by the protective tariff and bounty granted by the Dominion government, and a bonus of $2 per ton, which the Ontario government could well afford to give, there is every reason to believe that a prosperous smelting industry would in a short time be firmly established. The government of Sir Oliver Mowat has shown itself alive to the best interests of the province, and by its grants to railways and in aid of other enterprises has evinced a desire to promote the public prosperity in every way. There is a surplus of five or six millions in the treasury, a bonus of $2 per ton on pig iron would call for an expenditure of at most perhaps $75,000 or $100,000 a year, and the benefits which would result from the establishment of the industry would be such as to many times repay this outlay.

EN PASSANT.

Referring to the General Phosphate Corporation our London correspondent writes: "From what I hear there is a deadlock in this matter. The directors are willing to do something to help out the shareholders but not so much as is necessary, say £100 to £150,000, and the best opinion is that liquidation is inevitable. The Committee is still sitting, but as is natural, they have come somewhat to loggerheads with the official party. The early directors, on whose names so much of the money was subscribed, and who retired directly after, make a sort of virtue of this and say that they left the Company with ample and untouched capital, and they are not responsible for anything that happened since." This is a little like the muscular Quaker who objected to violence, but put an obtrusive burglar out of the window. He did him no harm and was not responsible for his hitting the ground somewhat hard. He left him alive and well 'just outside the window.'

Application has been made to the Lieutenant-Governor in Council for letters patent incorporating "The Talc Fibre Company of Frontenac and Hastings, Limited," with a capital of $150,000, for the purpose of working the talc deposits of Eastern Ontario. We understand that the company have secured nearly 2,000 acres of these deposits, and from the most scientific and practical tests, are convinced that the Canadian talc is fully equal in fibre-softness and floating qualities to any found in the United States, from which country, all talc used in the manufacture of paper in Canada, is imported. Arrangements have been completed for the erection of a mill at Kingston, for turning out the finished product, and it is believed that the talc will be placed on the market by the first of July. As Canada possesses almost fifty paper mills, all of which can use fibrous talc with profit to themselves, the new industry will commence business with an established market, and with every prospect of adding one more factor to the list, which means national development.

CORRESPONDENCE.

A Correction.

To the Editor of the Review:

SIR,—Your publication is usually so fair that I know you will be only too happy to correct an unjust inference which you seek to impose upon me in your February number.

With your general observations touching the relation of the Government of Nova Scotia to the recent coal mining syndicate I have no fault to find. They are in the main fair and very rational. But you step out of the way to discover an alleged inconsistency on my part—not a very serious one at worst—between utterances in January 1892 and January 1893.

Last year I was called upon to uphold the authority of the Nova Scotia legislature to increase the royalty on coal. In doing so I simply traced the history of the coal mining legislation of the province from the lease to the Duke of York (subsequently transferred to the General Mining Association), dated August 15th, 1826, for sixty years, to the present. That lease was honored until the date of its expiry, and no more royalty than 6d. per ton on round coal was ever attempted to be extracted until the full term had expired.

No one doubted that on and after August 15th, 1886, the Legislature of Nova Scotia had a right to increase the royalty. The only question at issue at all was whether the increase if made must not be made at the recurring periods of renewal. I was compelled, after due study and reflection, to advise the Government that no such limitation existed in respect either of the powers or rights of the Government, but that any time after August 15th, 1886, the legislature had unlimited powers to increase the royalty.

In my speech on the "Act for the further encouragement of coal mining," which recently passed the Nova Scotia Legislature, I never said one word inconsistent with the above. I did say that the existing leases of coal mines were irrevocable if the conditions were complied with and that they were practically for eighty years because renewal was compulsory. This is the gospel which we desire to preach as loudly and as widely as possible. But one of the terms of the existing leases says in plain words; "*Provided that the royalties may be increased, diminished or otherwise changed by the Legislature.*" The law requires that the Commissioner of Mines shall insert this explicit provision in every coal lease.

In January 1892, I was simply maintaining the power of the legislature to increase the royalty without in the slightest degree injuring the absolute validity and inviolability of the lease itself. In January 1893 I was simply upholding the validity and sacred character of the lease without impugning in the slightest degree the authority of the legislature to increase the royalty.

It may be urged by some that if the legislature has the right to increase the royalty, this power might be exercised in such a way as to lessen the value of the lease. That is possible, and, therefore, the Government of Nova Scotia have always been ready to give to existing lease holders a lease fixing a maximum royalty, which should never be exceeded during the entire term. The lease which has been recently authorized by the legislature, and which Mr. Whitney and his associates will likely take, is not a new conception; but the coal owners of Nova Scotia have long been aware that the permanent character of the royalty charge was always available for them if they particularly desired it.

But this much I must add, that notwithstanding the fact that the right to increase the royalty undoubtedly exists now in Nova Scotia, yet it is absolutely safe to rely that this power will never be exercised in an arbitrary spirit. Public opinion would never sanction the charging of any greater royalty than the industry could fairly bear. When the increase was made last year, no reasonable man will say that the coal trade could not infinitely more easily bear a royalty of 10 cents per ton, than it could bear 7½ cents per ton during the ten or twenty years preceding. The fact was that all well conducted companies were declaring handsome dividends in 1892 where they had barely been able to exist a few years previously. The fact that the coal mining industry can bear a royalty of 10 cents per ton is abundantly demonstrated by the fact that Mr. Whitney, whose sole object, I take it, is to make money by mining coal, voluntarily agrees to pay 12½ cents per ton royalty.

Of one thing always rest assured, the legislature—that is the people of Nova Scotia—will always keep rigid faith with all persons and bodies with which it has obligations or relations of any kind.

Yours, etc.,

J. W. LONGLEY.

Halifax, Feb. 14, 1893.

Purchase of the Walker-Carter Process.

To the Editor of the Review:

SIR—I learn from the best authority that the Walker-Carter process for treating gold-bearing refractory ores, which is now in successful operation at Marmora, Ont., has been purchased for Canada by Mr. Arthur Kitson of this city, who proposes to build a factory at New Toronto this summer, and commence the manufacture of the machinery pertaining thereto. The process has proven an immense success with the Hastings County ores. I learn this privately, but from undisputed authority.

W. J. MCLEAN.

Mutual Bay, Phila., April 24, 1893.

The Nova Scotia Mines Report for 1892.

To the Editor of the Review:

SIR,—Perhaps you may find space for the following curiosities, culled at random from the recently issued Mines Report for this Province:—

The report is dated Feby. 14th, 1893, and yet speaks for the year ending December 31st, 1892, at which latter date the year 1892 was completed and ended.

On page 12, it is mentioned: The coal in Scott pit tunnel was fired by a roburite shot on the 8th December. On page 13 the same occurrence is said to have happened on the 7th December.

Page 13.—"All the above shots were fired by electric batteries, and in mines where there is much dust I consider it safer than ordinary powder, but it is not an absolute safe process where there is gas."

Page 14.—Five times is the name of a certain pit given as Ford, and Five times as Foord.

Page 23.—"Since, a lower level has been driven and used for drainage and return airway, making a remarkable (sic) improvement. * * A hot well has been sunk."

Page 24.—"There have been no new feature of work in this mine during the year. * * Rooms have also been opened up there, at the time of driving those deeps and levels. * * An Ingersoll air compressor has been added to the plant driving three coal cutting machines, on in the east deep distance from engine 1,410 feet, two inches, the west deep 2,900 feet, they are giving good satisfaction."

The same locality is called in different parts of the Report, Caribou, Carabou and Carribou.

Page 25 says.—"A new pump *were* placed in the new deeps."

Page 26.—"A new pump has been placed in the drift, size 30 inches, stroke 9 inches, water 14 inches, steam cylinder. * * The engine is placed in the pit to the rise of the shaft bottom, and hauls the coal up the deep, and it is there let back to the pit bottom. * * As no reports of a workable seam *has* been made."

Page 32.—"His ideas which appear perfectly plain and practicable would I think if acted upon and carried out, be efficient and considerable saving to the company. * * The Copeland mine is down 100 feet. *They* have a fifteen stamp mill. * * The North Star Co. * * were down at date of visit, 400 feet, on an angle of from 20° to 30° south. There is also a westerley dip, caused by a roll in the measures."

Page 33 calls Harrigan Rock, Hurricane Cove; and spells Mr. Reid's name "Reade."

Page 34.—"A large water tank was placed about 20 feet down the shaft, and all the water from surface is caught in, thus leaving the mine," etc.

It is gratifying to be told on page 35: "There are also several groups of men prospecting around. The roads being largely improved during the past 2 years gives men an opportunity to move around and prospect the country."

Credit is not given to the source whence was taken the abstract of the Austrian Fire-damp Commission. Valuable undoubtedly, but in parts not thoroughly cooked *e.g.*, page 44 says "it lays down limits of percentages of gas for the three lamps above, which trying for gas may be dangerous." To digest this information it is necessary to know what they are, and this is lacking.

Page 53, Wentworth Creek? This quarry is in Windsor. It is a white calcining plaster.

Page 55, gives the value of limestone at North Sydney, as $2.08 per barrel, a manifest error.

On comparing this report with that for 1891, we miss the "statement of the number of classes of men employed etc;" data for this table is required of the mines and if it is not to be used, for what purpose is it asked?

On comparing it with report of still older date, we find omitted "the financial statements" "the colliery construction account," for which table data are required in the returns from the several mines.

Then we miss the "mineral leases" [other than gold] a most important table.

On going still further back in the Reports of the Department, we find "annual summaries" from each Gold District, which if it is not published every year, might well be occasionally

Yours etc.,

DONALD MACTAVISH.

Halifax, 30 April, 1892.

The Preservation of our Forests.

To the Editor of the Review:

SIR,—With reference to the resolution adopted by the recent mining convention at Montreal urging the Provincial and Dominion Governments to more rigorous and vigorous efforts for the protection of forests, the following facts are emphatic:

1. The area of timber limits in Quebec and Ontario sold since 1870 is approximately 10,000 square miles. "Fire follows the lumberman" partially for the reason that the settler follows the lumberman. The free grant system has so thoroughly swept out areas in Ontario that the fact is undeniable that the settler is reckless in the use of fire for clearing his land. He burns his own soil and his neighbors timber. The Crown Lands reports and the report of the Mining Commission call for interference against this member of the community.

2. The parties injured will not prosecute. I have known a large part of a township set on fire by a young fellow who wanted to clear up some land in August—a very dry season. It was impossible to get anyone to move in the matter, although the grumbling was loud and deep. There is no remedy—absolutely none whatever—under a suit for damages, (1) because the homestead law protects the settlers' land from execution; (2) because the Exemption Act practically protects all his few chattels. The fire rangers will not prosecute. There has only been one prosecution attempted by the province (government) of Ontario, and that I believe was settled.

3. Until the people are educated by stringent legislation, committed to public prosecutors to enforce, there will be no change in the present condition of affairs. As a matter of fact the license of occupation given to a free grant settler, is a license to burn up all the timber within reach of the effects of his blazing log-heaps. The Government says the settler must do so and so. The settler does as he pleases.

4. A practical remedy will be (1) to give or rather to require magistrates, on the complaint of any person or on any requisition, to institute an enquiry into the facts as to the origin of any forest fire, with power to send for witnesses and examine them, and to report the testimony to the County Crown Attorney whose duty it shall be to advise the Crown whether the evidence warrants an indictment for criminal negligence and arson. (2) A more active remedy, which would be automatic so to speak, would be to resort to the old English law which gave the injured party redress in damages arising from loss by fire, by assessing the loss on the township. This would make every ratepayer a fire guardian and an insurer at the same time.

To show the loss going on, I would cite the townships Hinchinbrooke and Bedford near Kingston, as one of several hundred illustrations which might be adduced: I own with some friends a tract of 1,500 acres, which today has not 150 cords of wood on it. Twenty years ago it was well timbered. A party of picknicking berry-pickers set fire to it one year; surrounding settlers the next; and in three or four years timber of the value of $15,000 was swept away. The land is worthless except as a mining tract. Hinchinbrooke which was the finest timbered township in eastern Ontario, has been swept by settlers' fires of timber worth ten times the utmost possible value of all the agricultural improvements which by any possibility can be attained by the settlement of this township. A careful estimate, township by township, throughout Ontario would show an aggregate loss—to which every year additions are being made—of probably $200,000,000.

Yours, etc.,

J. BAWDEN.

Kingston, Ont., 30th April, 1892.

A Peep at the Future of the Coal Trade by a Follower of the Black Art.

To the Editor of the Review:

SIR,—Do not be startled if I flash the mirror of fate before your eyes for a moment. Recent movements of an under-earthly character have so disturbed the workers in darkness, whose aim nevertheless is light; such fearful pictures have been sketched; Old Probability has been so drawn upon that his coffers of "likelies" are almost exhausted and imagination flickers with the weakening pulsation that precedes the offensive odour when light ends in smoke. All these have so disturbed my pursuit of the black art; I am so begrimed with the dust of coaly matter; my sight is so bedimmed by its quaquaversal movement, that....there! the mirror is turned, my distracted mind is relieved; and now it is turned again. And what have I seen? First of all that caught my eye were the words—not "abracadabra" or horrificabilimalitudinetatibusque"—but the plain unmistakeable words—nineteen hundred and thirteen. They were set in a dense haze which did not, however, affect or diminish their brilliancy. They seemed rather to have come out of this dark envelope, as if it represented the present intermedium of doubt, uncertainty and dread; and they had rushed to the front to put a good face on it. Nineteen hundred and thirteen, I muttered to myself, and as I repeated the words, the representation of them gradually assumed the shape of a hand with a beckoning finger. I followed, in Asmodeus fashion, clinging to the tip of the finger, and was set down on the edge of a cliff against which a mighty, boundless ocean dashed its endless waves. Noiseless they burst against the opposing rock, no crash of watery volume, no whish of broken force reached my ear: it was filled with a noise of the like of which I have no experience. There seemed to be a mingling of the clatter of the machinery of a cotton factory with the clinching, deafening thuds of a boiler shop or an iron-ship-building yard; and, now and then, as if striving for the mastery, a rattle as of tons of pebbles dropped from some altitude on an iron floor.

Amazed and astounded I looked round for the cause of this extraordinary din. The sky was clear, cloudless, no jar of the elements seemed present. As I gazed I noticed that the horizon was shut out from sight by huge erections

in front and on each side of me. Intermingled with these was a large number of moving structures of like form, but less stature; they were floating vessels, and were passing into and from the ocean with steadiness, in rotation of the ebb and flow of the tide.

Directing my steps towards one of these peculiar looking buildings, I gazed on a sight that struck me with astonishment. From the top of a tall structure of iron, which was placed over a coal mine shaft, I saw, issuing with an unceasing movement, huge masses of coal with a steadiness of motion akin to that of a column of water, passing into an iron box or shoot leaning at an acute angle into the top of a large iron tube on the deck of the vessels.

The shaft tube had openings in it like windows, in alternate position, from near the bottom of the tube to the top, out of which clouds of dust came flying, and showers of slack coal falling on the outside of the tube. While I stood in admiration of this wonderful operation, I observed a vessel leaving the position in which it had taken a cargo of coal. Nothing was perceptible of the means of motion; no smoke funnel was to be seen; no masts; and, adding wonder to wonder, I saw the tube through which the coal had passed into the vessel disappear in telescopic fashion and present only a short projection above the deck.

I was bewildered: surely I was dreaming: this was an impossibility in 1893; how is it done in 1913?

An intelligent looking man was passing; I spoke to him; he courteously exchanged remarks on the weather and I soon interested him in my curiosity.

The flow of the coal from the top of the shaft tube into the vessel was quite intelligible, but how was the coal sent up from the bottom of the shaft? Forced up, he replied. Forced up by what means? I inquired. Why, sir, in piston fashion. But by what motive power? Electric was the answer. Electric how obtained? By insulating a large extent of the mine and thus accumulating a reservoir of productive power, like a steam boiler, and applying it as I have likened the action. Wonderful! wonderful! I uttered; but tell me, how is the supply of coal obtained in such flowing quantity in the mine? By electric machines, he answered. There are three in operation at once: two with a horizontal action, one of which cuts along the top of the seam, the other cuts the bottom; and the third machine has a vertical action and cuts along the back of the horizontal severances and thus completely separates a large mass of coal. An electric ram or buttor, as it is called, shoves the entire mass over the roadway where it breaks and falls into large boxes and is hauled by electric motors to the shaft, there it is dumped into the elevator and is shoved up as you have seen. You noticed the vessels, I suppose, he added. Yes, I replied; they too seem to be of a mysterious character. Not more so than the mine operations he answered. But where is their motive power obtained? Electric sir, electric. That may be, but how started? what sets the motors agoing? Bottled power, sir, enough and to spare is stored in a condensed form to last the voyage. And do these vessels perform the trips with regularity? Oh! yes, they come and go at fixed periods. But surely the weather must often disconcert this regularity? Oh! no, not at all, they have a gas-generating apparatus on board, and another for converting the gas into oil which is lavishly poured on the water when a gale springs up; and thus they glide along steadily, unimpeded, and maintain the regularity I have named. When they reach the port of discharge, he continued, the loading tube is raised aloft, a connecting tube or spout is attached to the top thereof, a like action to that in the coal shaft is set to work in the vessel and the cargo is dumped into the coal yard at a rate of discharge equal to that with which it was taken in. I was amazed, nay dumbfoundered. I must be dreaming. This is all bosh, my friend, I exclaimed. Not so, he said. Well, but tell me, where does all this coal go to? To all parts of the earth, he replied. And in what part of the earth am I now, I asked! In Cape Breton.

R. V. WINKLE.

Sydney, 1st April, 1893.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Ontario.

Kingston District.

It is probable that active mining operations will soon be developed in the townships of Barrie and Clarendon, county Frontenac. Veins carrying mispickel, antimony, copper, lead and silver, have been opened on lots 10 to 14 in the 8th concession of Barrie. Pocket specimens passed to college professors for analyses have shown the usual astonishing results obtained from selected samples. There seems to be no doubt, however, that the find is a remarkable one. If the Ontario Government wishes to make its Bureau of Mines something more than an annex of the Crown Lands Department, an expert with a diamond drill will be sent into this township and also into Clarendon, Tudor and Bedford for the purpose of showing to the world the permanence or otherwise of the galeniferous deposits of this region. The Geological Survey might also lend a hand in the investigation of this district. The work begun by the late H. G. Vennor is very incomplete, and much remains to be done to give the enquiring minds of investors and miners any adequate notion of the stratigraphy of the district. If an effort is made to take advantage of the prospecting which always follows discovery in a new district, there may be laid the foundation of an important mining industry, but if the aloofness of the Departments creates the impression abroad "that there is nothing in it," the prospectors labors will be in vain, and the usual Canadian torpidity will ensue which nothing short of a bonus or bounty will remove. There is an opportunity at hand for either Governments, or both, to show willingness and capability to aid in the promotion of mining enterprise.

Perth District.

Capt. Robert C. Adams, of Montreal, and some New York friends have purchased from the Anglo-Canadian Phosphate Co., Ltd., the Otty Lake mines at North Burgess, Ont., and on 1st May will begin mining for mica. The property contains some three thousand acres, is equipped with a good working plant and is situate a few miles from the town of Perth. It has been extensively worked by the old company for phosphate. We heartily wish the genial captain success in his new venture.

Quebec.

Ottawa County.

The Blackburn phosphate mines in Templeton were closed down on the 1st of April, and the men all paid off. The property has reverted from the English company, who operated it under agreement, to Mr. Robert Blackburn, Ottawa, the former owner.

Several seizures were made on Lee Brothers mining tools (mica and phosphate) on Lot 4 in 9th Range, and 18 in 10th of Templeton. Eighty-five tons of 80% and twenty-five tons of 70% phosphate sold for $350; the mining tools and three tons mica for $45. Fifty-three barrels of rough split mica at the Templeton station were bought in by Rochon & Champagne, the Hull notaries, for $300; and twenty-five tons rough mica were purchased by McRae & Co., for $100. All the claims, with the exception of about $150, have been satisfied. The Hull lawyers got quite the best of it.

The Lake Girard Mica System are rushing work on the Murphy and Charette mica lots. About 40 men will be employed.

George and John Wallingford are opening up Lot 16 in 9th, with seven men. About 8 tons mica have been extracted during April.

Messrs. Powell and Clemow have resumed work on the Godson lot with 10 men.

Mr. Lewis McLaurin has commenced working mica on the McLaurin property, employing a small force.

McRae & Co. are working the Allan and Fleming, Lot 28, in 4th Range of Wakefield, for mica. E. K. Roche is superintending operations with 12 men. This property is opening up well.

Capt. Adams' Lot 10, in 2nd Range, Portland West, has been bonded to McRae & Co., Ottawa. Tom Lyons, late superintendent of Canadian Phosphate Co., is opening up the claim for mica with 10 men.

The Lake Girard, Nellie and Blanche, and Perth mica mines, are turning out usual amount of material for the System.

Mica exports from Ottawa for April were a little over $6,000.

Messrs. Jamieson and Wright are rushing things at the Cassidy mine, and are turning out the biggest sized mica in the country.

Messrs. Brennan and Dowler are opening up Lot 23 on 2nd Range of Portland West. Archy Woodhouse is foreman with 10 men under him.

Messrs. Nellis and Gemmill have abandoned the big pit at the Gow mine and are working on the surface again. About 150 tons mica stored ready for cutting. It is generally understood that the firm intend putting up a cutting house near the mine—the machinery having recently been purchased in New York.

The High Rock Mine is turning out better this season than ever before. Immediately behind the Compressor House on the hill, an immense show of phosphate was opened up three or four months ago, which keeps on improving as work progresses.

Mr. J. Burley Smith, (British Phosphate Co.) has about 4,000 tons of 60, 65, and 80 per cent. phosphate ready for shipment this season. Mining operations will likely be suspended soon, and extensive diamond drill tests will be made in order to locate the big bunches.

Messrs. Poulton and Lamb, who have been working mica and phosphate on Battle Lake for the past six months, have closed down for a time owing to the illness of Mr. Poulton. About 20 tons mica and 60 tons phosphate were mined during tho first four months.

The Kootenay and Columbia Prospecting and Mining Company have had a second Kelly Sectional Boiler built at Messrs. Powers & Co., for the Stanley mine, Kaslo, B.C. A carload of machinery and mining outfit leaves Ottawa about the middle of May. Ten miners under charge of James Kelly will leave for the Slocan about the 10th of May.

Quite a number of prospectors are at work looking for mica in the rear part of the Township of Hastings. Some fairly good shows are being developed. Messrs. Smith and Lacey are working their old white mica property in that district.

Saguenay District.

Messrs. G. B. Hall and Daniel McGill have been making considerable shipments of white mica to New York and Boston from their property opened up last fall in the Saguenay district. About 2000 lbs. of cut sizes from 2½x3 to 7x9 have been sold this month.

A New Sectional Boiler for Prospecting Purposes.*

By HECTOR MCRAE, Ottawa.

Owing to the difficulties and expense in the transportation of steam boilers into a mountainous mining camp, Mr. James Kelly Ottawa, recently hit upon a scheme for the construction of a sectional boiler that could be packed without trouble over mountain trails. The first boiler on this principle was made in Ottawa, in December last; and six weeks after the order was given to the manufacturer, was working on the Wellington Mine, in the Kootenay district, B.C. The sections were packed in strong cases of about 500 lbs each, and were undisturbed till they reached end of wagon trail, about 2½ miles from the mine, where the cases were opened up, and the boiler packed in on ten mules.

The mule trail was cut through 9 feet of snow the full distance 2½ miles. The mine is at an elevation of about 3,500 feet, and the actual cost of transporting the boiler up the trail was less than $50.

An outfit consisting of section 10 h.p. boiler, mining pump, diamond drill, tools, rods, &c., was packed in and commenced work inside of 2½ days from time of arrival at end of wagon trail. The boiler is simply constructed. The shell plates are bolted together instead of being riveted; the heads of the bolts are inside the shell, and before the nuts are put on are wound tightly around with gasket; iron washers are then placed next to the shell and the nuts screwed up tightly.

The crown sheet at the fire end is countersunk, through which the tubes are inserted, and the tubes at this end are flanged. At the other end they are threaded; washers are then placed on them, and after being gasketed thoroughly are drawn tightly into place by buckles. Three perforated tubes are placed in the interior of the boiler, in the inside of which run three tubes; this is done to keep the crown sheets in place. The smoke stack is also put together in same manner as shell of boiler, with short bolts and nuts, and the links go over each other like an ordinary stovepipe. Instead of the heavy cast iron grate bars, one inch round iron rods, about two inches apart, are passed through the fire box, and are held in place by nuts, with washers bevelled to fit the curves of the box. It is not claimed that the wrought iron bars will last as long as the cast, but as wood fuel is generally used, the wrought iron bars suit the purpose very well, and being about one-sixth the weight of cast iron bars are more convenient to handle, and can be easily removed at a slight cost.

The total weight of a 10 h.p. boiler is 2,000 lbs., made up as follows:—

4 shell plates, 160 lbs. each	640
2 plates, fire box	320
2 crown sheets	280
Grate bars	60
Extra grate bars	40
Tubes	600
Bolts, nuts, &c	60
	2,000

Weight of cases, about 200 lbs.

Boilers of any required capacity can be made on this principle.

* Paper read before the April meeting of the General Mining Association of Quebec.

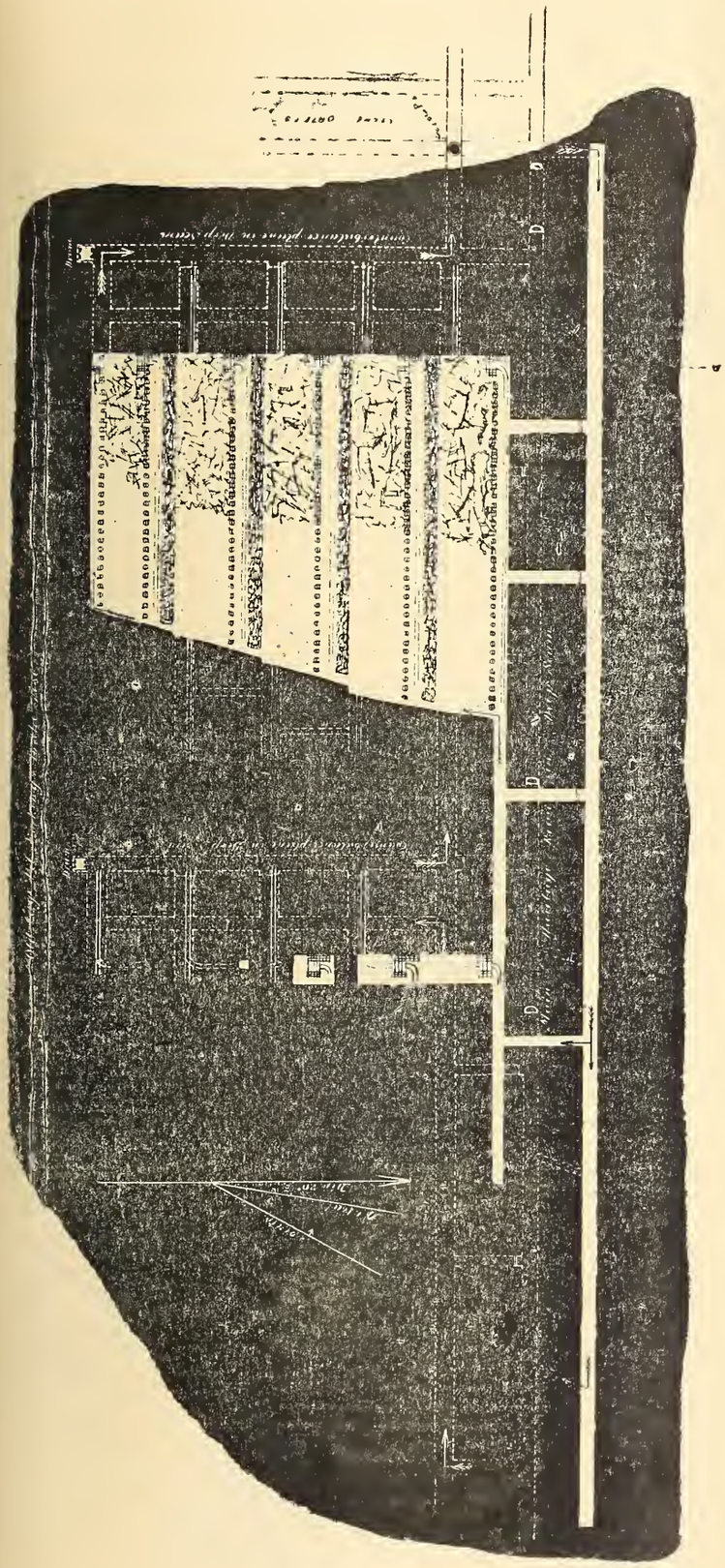


FIG 1 — PLAN OF LONGWALL LITTLE SEAM, ALBION MINES, PICTOU CO.

MODIFICATION OF WORKING COAL IN NOVA SCOTIA.

Plate I.—Illustrating Mr. J. G. Rutherford's Paper.

Doors are shewn thus D; brick stoppings thus, =; canvas doors and stoppings thus, |; white arrows show air current in deep seam; black arrows show air current in little seam.

MODIFICATION OF WORKING COAL

Lately Introduced in Nova Scotia.

[Being a series of papers contributed to the *Transactions* of the Mining Society of Nova Scotia.]

[1] Pictou County.

By Mr. J. G. Rutherford, B.A., M.E., Stellarton.

The method of getting coal by Longwall is not entirely new in Pictou County. Some old crop workings on the deep seam were operated on this system previous to the year 1828, and in 1860 a small area of the oil-coal or Stellar seam was worked in a similar manner by the late Mr. Henry Poole; but the practice has almost generally obtained of working by the bord and pillar method, by which from 30 to 40 per cent. of the seam is got on first workings. In some noteworthy cases this forewinning has been rapidly and successfully followed by pillar drawings or as termed in the north of England "working the broken"; in others, this inherent principle of working by bord and pillar has been lost sight of or voluntarily ignored.

The main or highest workable seam—some 30 or 40 feet thick—of the Albion series, has been extensively worked on the latter system, and much of the coal left primarily in pillars has been subsequently extracted. To the dip, however, a large area of workings exist in which no pillars have been robbed. The deep or cage pit seam which underlies the main, separated by about 156 feet of measures principally brown shale, has also to a considerable extent been worked on the same system, and a small proportion of the rise pillars were successfully withdrawn, but evidence of a gob-fire existing having been observed, the district was speedily abandoned and built off from the rest of the mine.

When the workings on these two valuable seams were temporarily rendered unproductive by the explosion in the Foord Pit in 1880, and the subsequent firing of both seams, attention was at once directed to the immediately underlying seams—hitherto unwrought—viz.: the 3rd and McGregor. Crop openings were made and the work laid out on the bord and pillar method. The main slope of the 3rd seam is now down a distance of 1880 feet from the entrance, and the vertical depth of the lowest level is 700 and odd feet. From this point a pair of stone drifts or tunnels were set away with a slight rise across the measures, which would enter the overlying deep seam at a point below the lowest of the old workings of the Cage Pit. After passing through very hard strata the seam was penetrated at a distance of 219 feet and presented the following section taken vertically to the place of stratification.

Thill or pavement—Brown shale.

	Feet.	Inches.
COAL (good)	3	10
Coarse coal and shale	8	7
Shale with ironstone nodules		11
Coarse coal	3	10
COAL (good)	13	4
Coarse coal with ironstone bands	3	6
COAL (good)	4	3

For the purposes of this paper, the names applied locally to the different divisions of the seam will be adopted, and hereafter the main or 13 ft. 4 in. portion will be known as the Deep seam, and the highest or 4 ft 3 in. part as the Little or 4 ft. seam.

The Deep seam having been worked to some extent a few years ago, its character is pretty well known; but with the exception of a small pair of dip slants for drainage purposes, the Little seam, in which the recently adopted longwall work is carried on, had not hitherto been worked. It may be well then to describe it. As shewn in the section it is 4 ft. 3 in. thick, and is a clean, bright coal from roof to pavement. There is a variable amount, generally 12 to 14 inches, of excellent cannel next the floor. Proceeding in an easterly direction the cannel is gradually replaced by coal similar to the upper part of the seam, but more lustrous and of a freer nature. The cleat is well defined and at right angles to the bedding plane. It bears about 10 degrees east of full dip; the latter being N 45° E, at an angle of 20° to 21° increasing in a westerly direction and growing lighter towards the east. The seam is traversed by a system of parallel joints, bearing about 29 degrees east of the dip and seldom farther apart than a yard, frequently as close together as six inches. These joints do not extend upwards beyond the coal, but are observed in the pavement and underlying Deep seam. They hade with the dip of the seam at a light angle. While lypes or backs are frequent in the Deep seam, running in every direction, they are seldom met with in the Little seam.

Method of Working—When the Deep seam was reached a main or haulage level 9 ft. by 8 ft. high was turned away right and left or in an easterly and westerly direction. Rise headings were put up at intervals and connected in order to form a return airway, and a stapple pit some 16 feet deep was sunk to the back or return stone drift. Tunnels or drifts were driven into the Little seam also from the same level, and additional levels set away in that seam right and left parallel to those in the Deep seam. These form the intake airways of the mine. Beyond driving the exploratory levels on the west side, nothing further has been done; so that this description of the mode of working refers to the east side only,—although in the course of time, it may be adopted throughout the mine. Furthermore, it must be borne in mind

that so far as the work has progressed, it has been conducted on a limited and purely experimental scale.

Counterbalance planes, 400 ft. apart, are driven to the full rise from the main haulage level in the Deep seam, and as near to the old sealed workings of the Cage Pit as is considered prudent, the proximity of these old workings being proved by bore holes. From these planes, bords 12 ft. wide and separated by pillars of coal 47 ft. thick are turned away to the left, and when they have been driven in a distance of 66 ft., drifts or tunnels 6 ft. square, are started from the low side of each bord and nearly at right angles to them and driven on a rise of from 1½ to 2 inches per yard until the Little seam is reached. Connection is then made in that seam between the several tunnels or drifts, and the longwall face thus established. Timber chocks 9 ft. long by 4 ft. wide are built on each side of the tunnel where it enters the Little seam, and booms of large dimensions stretched across, in order to protect it when the weight comes on. The length of wall or face assigned to each set of men, is governed by the dip and thickness of pillar left between the bords in the Deep seam. It is now about 51 feet. As the face advances, it becomes necessary to afford support for the roof, in order to keep the roadways open for the transport of the coal, and for this purpose, principally, the roof is blasted down or as locally termed "brushed." The roof so far as it has been penetrated consists of fireclay of varying degrees of hardness, that immediately overlying the coal containing much ironstone in nodules. At from 2 feet 6 inches to 3 feet from the top of the seam, there is a parting of soft black fireclay and the first brushing generally extends up to this. The amount of stone brought down is not more than sufficient to build a pack wall—from 9 to 12 feet wide—on the low side of the roadway, consequently timber chocks 4 feet square and not farther apart than 2 feet are built along the high side and filled in with any loose debris there may be lying about. The width of the roadway or gob-road properly speaking, is about 9 feet—that is between the packwall and the chocks, and the space between the chocks and the packwall to the rise locally known as the "cundie"—(Scotch for conduit)—is therefore not greater than 29 or 30 feet. Props are set at variable distances apart along the face to secure the men, but in no instance has the roof fallen nearer to the face than 20 feet. Occasionally falls of roof up to the black fireclay parting take place back in the cundie but they are of no moment. The lower end of the face or wall is kept slightly in advance of the upper part as shewn in fig. 1.—and thus affords full advantage to be taken of the direction of the cleat and joints. The line of fracture of the roof runs slightly to the west of full dip.

As the face advances, the heaving of the pavement is soon noticeable, and the back props—many of which are left in, are readily broken. The general effect produced by the extraction of the coal, appears, so far as observed, to partake of the character of a creep, inasmuch as there is a gradual subsidence of the roof, coupled with an upheaval of the floor, equally as regular in movement. Packwalls and chocks at the outbye end of the work, which, six months ago, were over 4 feet thick are now compressed into a space of less than one foot. This coming together of the roof and pavement necessitates recourse to more brushing and at the present time the outer end of the gobroads is almost entirely up in the solid roof.

While the operation of drifting into the Little seam is in progress, the bords in the Deep seam continue to advance, and the lead thus obtained is held until the limit or divisional barrier between the balances is reached. The ratio of advance as regards the bords to the longwall is as 3 to 1 and the output per man employed is very slightly in favor of the bords.

Each wall or face is let to a set of men, generally four in number, and they are paid a fixed price per ton for all coal sent to bank which is practically the whole seam, for there is no loss or waste in working. The brushing is paid for by the lineal yard and for these two considerations, the men undertake to do everything in connection with the work, excepting the firing of shots, which is done in compliance with the law by the deputy overman. The quantity of explosive used compared with the consumption in the bord and pillar work generally, is about one third. The undercutting or holing is done in the bottom part of the seam, as there are two thin bands of hard ironstone separated by an inch or two of coal, immediately under the seam. The holing extends forward from three feet six inches to four feet, and as the jud is formed, sprags are used to support it until the undercutting is completed, when they are withdrawn and the coal brought down. Instances have occurred where the greater part of a shift has been employed in undercutting the whole length of the face, and on returning on the following day the jud has been found to have come bodily away and broken up into large masses. The opportunity of learning the proportion of round or lump coal produced by the longwall, for comparison with the quantity from the bord and pillar work has not yet occurred, because the output from the little seam being small, no care has been taken to keep it separate from the produce of the other parts of the mine.

The ventilation is simple. The intake air enters by the main stone drift and passes at once into the level in the Little seam. It splits at the inbye heading in that seam, and while sufficient is taken directly to the longwall faces, the bulk is made to traverse the workings in the Deep seam. At the highest point in the longwall working, a small pit is put down on the bord below, and the return air meets at this point, the return from the the Deep seam, and together they travel down the balance, along a level to the stapple pit and so into the

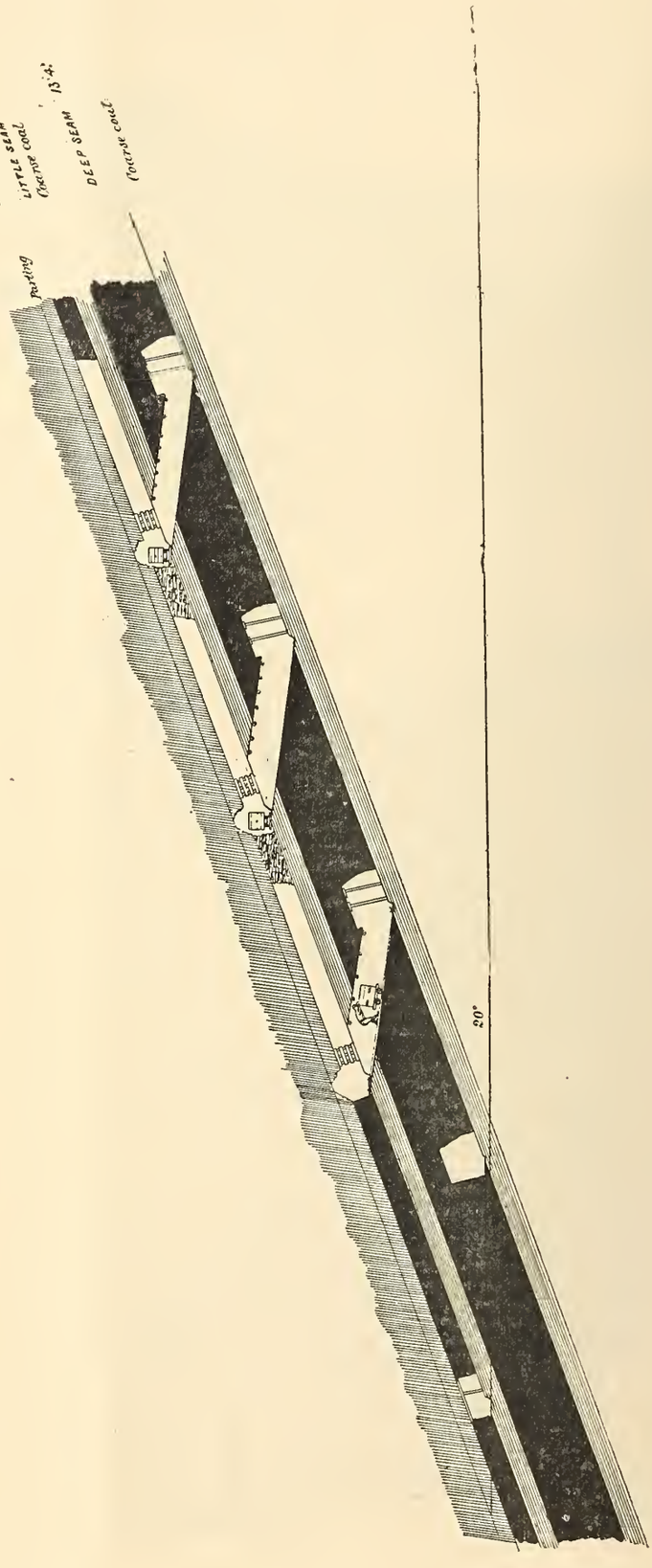


FIG. 2.—PARTIAL SECTION ON LINE A.B.

MODIFICATION OF WORKING COAL IN NOVA SCOTIA.

Plate II.—Illustrating Mr. J. G. Rutherford's Paper.

back stone drift and thence by the return airways in the third seam to the fan shaft or upcast.

Of course the intention is, when the longwall face shall have reached the barrier proposed to be left next the inbye balance, to withdraw the underlying pillars in the Deep seam, but with what success this may be accomplished is as yet a matter of conjecture.

When the circumstances are favourable—and in the case just described this appears to be so—the advantages to be derived by working on the longwall method are too well known to need comment here.

With respect to the drawings accompanying this description, it may be well to add a word or two in explanation. Fig. 1 is intended to represent the longwall work in the Little seam, and the underlying workings in the Deep seam are shewn by white dotted lines. The balance on the right hand is the one at present in operation, and the one further to the east or left, is intended to represent the process of developing a new longwall face. It will be apparent that by this system of working, the connterbalance planes in the Deep seam carry all the coal given both by the longwall and the bords. Moreover, another important advantage which the method affords, is gained by working in panels or districts separated by barriers of coal, for in the event of a gob fire, and such are not unknown, the facility with which a district can be speedily isolated is readily apparent.

It will be observed that the three lower bords of the left hand balance, have been connected with the Little seam by means of the drifts. The two lowest of these drifts have in turn made a connection with the Little seam, while communication between the second and third headings is not yet completed. The fourth has nearly effected an entrance into the Little seam, and the fifth is only about half way through.

Figure 2 is a partial section on the line A. B. and shews the method of connecting the two seams by the drifts, through one of which a box of coal is being brought to be placed on the balance cage in the lower seam. The packwalls of stone are shewn on the dip side, and the timber chocks to the rise.

[2] Acadia Colliery, Pictou County.

By Mr. James Maxwell, Manager of the Acadia Pit, Acadia Coal Company, Westville, N.S.

The seam dips at an angle of 27° to 30°, and until the workings reached a vertical depth of 1,200 feet, the method of working was by driving back balances to the full rise 400 feet, and breaking off bords on a level course inbye for a distance of 400 feet, and then working the pillars on a nearly straight face to the full rise back to the balance.

Where greater depths were attained the method that had answered so well heretofore failed, and it mattered not how narrow the primary openings were made, the pressure soon wrecked them. A change of system became inevitable. As narrow places could not be kept open by timber, even where placed skin per skin, it was determined to try an opposite course and make the working places wide. So far successfully, and the method adopted is to drive headings 26 feet wide to the full rise or pitch of the seam, carrying up on the intake side 2 feet from the cone a packwall with timber 5 feet wide, a space 6 feet wide is then left for a travelling way and for working a counterbalance that takes up timber. Then follows up the centre of the heading a chock pack 5 feet wide separating the travelling way from the coal chute, which is made 6 ft. wide. Another similar pack 5 feet wide, forms the other side of the coal chute, and being placed 2 feet from the coal makes a return airway when the heading is being driven up.

At right angles off the chute, walls are started every 12 yards, and a pack 5 feet wide is carried on the low side 2 feet from the wall; then a space 7 feet wide serves for the track on which the tubs run to and from the working face. A continuous chocking 5 feet thick on the high side of the road leaves an open space about 17 feet wide to fall in, which it does on every advance of 5 or 6 yards. These falls return the pressure on the roads which stand fairly well for a distance of 200 feet, the length between the headings.

The thickness of coal worked in these walls is 6½ or 7 feet. In the roadways other 2 feet of bottom is taken up and the material stowed in the packs. The height of 9 feet thus obtained is generally sufficient to allow for the settlement due to the pressure. The chocks on the low side of the roadways are placed about 3 feet apart to leave space for stowage. The chocks on the high side are placed close together to prevent the gob from falling on the roadway.

The face is not in a straight line, but worked in steps the better to prevent it being closed, which it is apt to do when the falls take place.

The shales forming the roof are very soft, and require cross timbers every 4 feet resting on the chocks.

The chock wood is taken up in schooners, long narrow bores running in a 16 inch track with a passing place in the middle of the travelling ways. The schooner at the top of the heading on being loaded with coal, acts as a counterbalance to take up the one below loaded with a less weight of chock wood. The coal from the faces is dumped into the chute down which it slides on iron sheets to the level below, where it is loaded with boxes carrying a ton each.

It is interesting to note that while bords 9 ft. x 7 ft. within a few weeks of being driven were reduced in size by the pressure, both on the tops and sides to such an extent that a box 4 feet square could no longer pass, places driven wide and but little higher to allow for the settlement of the strata have required but little attention to keep them open.

[3] Joggins Mines, Cumberland County, N.S.

By Mr. James Baird, Maceau, N.S.

The seam of coal at present worked at the Joggins Colliery lies at an angle of 17 degs. with the horizon and is opened out by a slope driven in the seam direct to the dip, a distance of 1900 feet or 2300 feet to the face of our present sinkings and the vertical cover at this point is about 670 feet. The seam is from 6 to 9 feet in thickness and of the following section in ascending order :—

Bench coal	2 feet
Fireclay	1 to 3 "
Fall coal	3 to 4 "

There is a good hard roof, the sandstone in some places being in contact with the coal.

Up to September, 1890, this seam was worked by bord and pillar, but on taking charge of the mine at that date I altered the system to longwall pure and simple as it is termed. The fireclay band being of too soft a nature to build walls with, I was obliged to adopt wooden butts 8 ft. by 4 ft. built as shown on the accompanying sketch and for this purpose I used mostly any size or kind of timber I could get. I found the best plan to keep our roads and faces safe was to place the butts lengthwise to the roads and not farther apart than 4 feet. As will be seen by the plan, I had a good chance to try the different methods of keeping roads and face of work. The cross-roads or half angle across the dip I consider a good plan. They are rather steep for horses but work well by self-acting inclines. We drive these places 360 feet which I am of opinion is a good length for roads straight uphill or half across and with seven or eight working faces of 50 feet to each set of men, makes good work. The straighter the face is kept the better; no jogs nor corners to take extra weight.

When the seam is 8 feet or over in height we can run our tubs with very little brushing. I might mention one point in longwall working is to have the right plant, viz.:—narrow gauge and low tubs, put in at first; it is much easier to make plant for the mine, than to make the mine for the plant. The roof sometimes bends quite gradually; at points, it breaks heavily. We have been very fortunate in the way of breaks, never having had a butt thrust out of its place and the roads have always kept good under the most severe strain.

The system of ventilation is simple, most of the air travelling along the different faces of work as shown on the sketch.

I also give a sketch of faults met with on our 1900 feet level going east, which we have put through successfully with our longwall work and I have yet to learn where the extra cost comes in compared with putting through faults when working bord and pillar.

Some writers claim that longwall pure and simple, can be worked only in thin seams lying flat or at an easy angle, with a good hard roof, free from faults, &c., while others say that any seam lying at any angle and with any kind of roof can be worked by that method. I fancy that the first miner of coal was a longwall worker, and that the first break of the roof made him alter his system, and there have been a good many men follow him in that way. In longwall the great difficulty is to keep the face of work secure in order that men may mine and load their coal easily and in safety. The first break of the roof is looked forward to with interest as it is always a test of the butts or buildings put in to maintain the roadways, or as some claim., whether the roof is too hard or too soft for longwall work.

I may draw your attention to the fact that our present lift is being sunk on the long-wall system. You will notice that we are taking all the coal out, not even leaving slope pillars, but building butts of timber on both sides, and I consider it will be, when finished, and the measures once settled down, the best part of our slope.

Generally, every few years slopes have to be retimbered, and especially where the pillars have not been left large enough, great expense is entailed in maintaining them in order, but in this case by longwall, once timbered forever timbered. Certainly I lay myself open to criticism in this assertion, but I hope to be able to defend my action.

As we must all learn by experience, and if that experience does not cost the companies we work for anything, but saves them money, then we, as managers, should be safe in experimenting.

In conclusion, I can safely say that the adoption of longwall at the Joggins has been a benefit to all concerned; the miner gets more coal with less labor. A greater quantity of timber is consumed, but the additional cost is more than offset by the other advantages.

No explosive is used by the miner in getting the coal and only a very small quantity in brushing the main roads.

[4] Gowrie Colliery, Cape Breton.

By Mr. Charles Archibald, Cow Bay, C.B.

In responding to the request of the Council to read a brief paper on the system of working coal at the Gowrie mines, I do so feeling that it will not contain anything new or interesting to my mining friends. The intention I understand is to get opinions at this meeting on the longwall system of working. The pillar and room system has been universally adopted at the coal mines in Cape Breton, until the Gardener mine very recently changed from that system to longwall.

The MacAulay seam worked at the Gowrie mines varies in height from 4 ft. 8 in. to 5 ft. 6 in., but the usual or mean height is 5 ft. It has always been worked on the "pillar and room system." For many years the rooms were driven six yards wide and the pillars from five to seven according to circumstances.

The coal dips at an angle of 8½° clear, the crop flattening as is usual towards the basin, and for the past ten years the dip has averaged about six degrees. The method of working is as follows: Two levels, the upper or main, and the lower or water level, are driven nearly on the end of the coal with a ten yard pillar of coal between and the rooms are turned up the hill or to the pit from the main level. The coal dips to the northward, and while the levels are about seventy degrees west of north, and correspondingly seventy degrees east of south, the rooms are all driven south. The upper level is driven ten feet wide, the roof being good and safe to allow this width, and spare roads can be laid down without the expense of widening; the lower or water level, is about eight feet in width. Cross-cuts are made usually one chain apart, and slant roads take the place of cross-cuts where required.

No powder is used except on the levels and cross-cuts; the coal is undercut or holed about three feet, or a pick-handle, sheared on one side of the room and brought down by steel wedges. The nature of the coal of course favors the wedging system, as there is a perfect parting at the roof, and a roof coal varying from four inches to eight inches which is separated and stowed in the roof.

For many years the rooms were driven narrow, or the ordinary width of six yards; the roadway was laid up the centre of the place and the roof coal, and when the coal was riddled the slack was stowed on each side of the roadway against the pillars. The expense and inconvenience of clearing the pillars to remove them was one of the causes that induced the change of working, and about twenty years ago the plan of driving the rooms ten yards wide and leaving the pillars the old width was adopted and has continued successfully ever since. By this plan the roadways instead of running up the middle of the room, were laid about three feet from the side of the pillars; the centre of the room was well timbered, and the roof coal and any refuse was thrown or stored in the centre of the place, thus leaving the face of the pillars clean. The pillars were removed to great advantage and with comparatively little expense; the rooms were driven to a counter level, and after leaving a pillar sufficiently strong to protect the roadway or counter level, the pillars were brought back; the rails being taken up on the retreat and the top allowed to come in. Besides the advantage gained by cheapening and facilitating the withdrawal of the pillars, the wide room, or, as it might be termed, the semi-longwall system, enabled the getting of more coal by the same number of men than if they worked in narrow rooms. Another felt advantage was that a larger percentage of coal was drawn for the same amount of narrow work before the removal of pillars. By narrow work I mean levels and cross-cuts, as for example roughly, the rooms being ten yards wide and the pillars six, we get ten-sixths or one and two-thirds as against one, or two-thirds more. The removing of such a large percentage by rooms may not appear to some a pecuniary advantage, as miners are generally paid at a less rate per ton for removing pillars, but my experience in working the MacAulay seam has proved that the wide room system beside other advantages has been a pecuniary success.

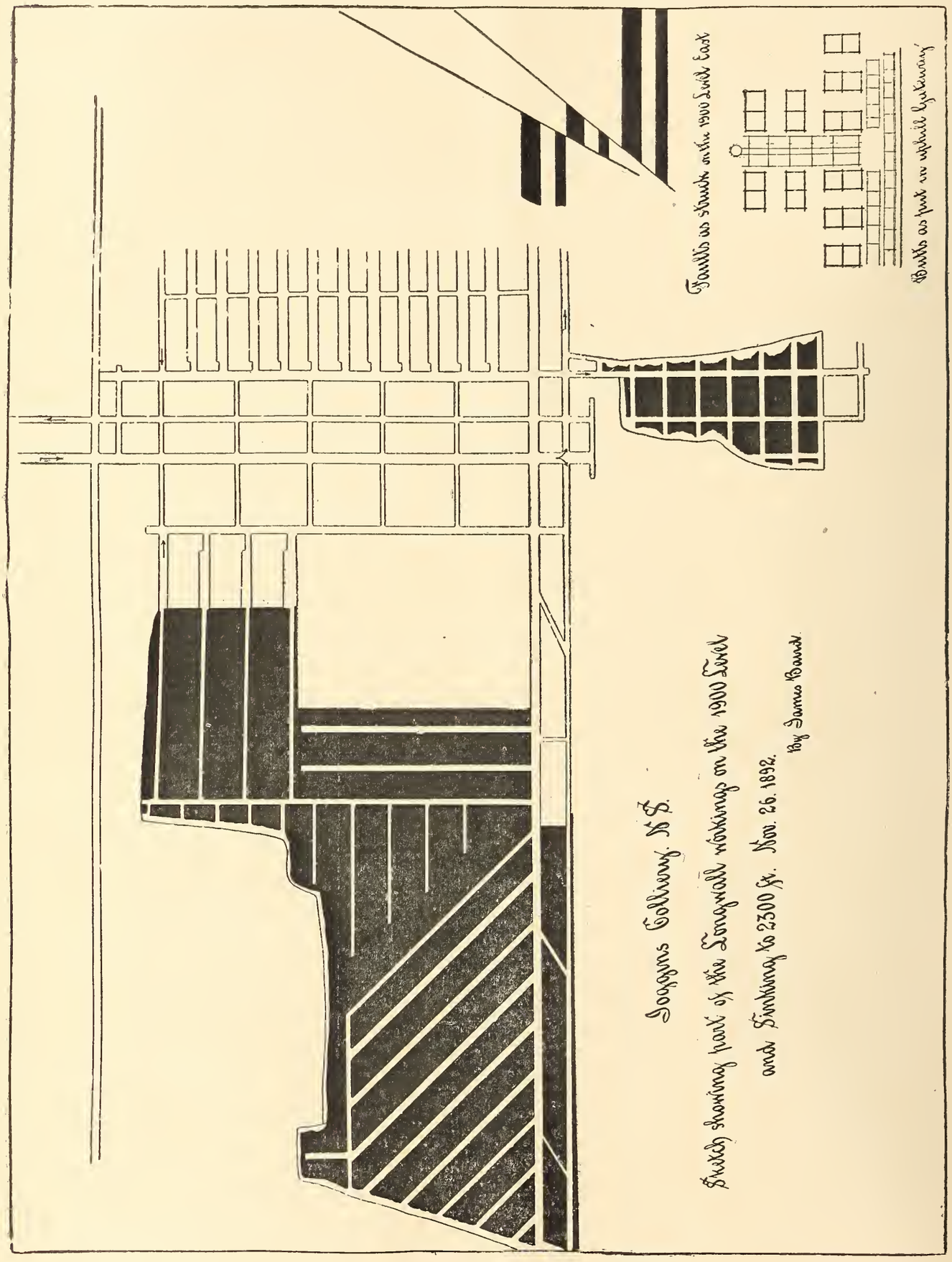
I am well aware that the working of wide rooms successfully depends upon the height of the seam, and more particularly on the nature of the roof; and in a mine where close timbering was required, it would not pay, and in many cases would be impracticable.

The roads laid up each side of the room are kept about three feet from the pillar; the space allowed for the roadway is about six feet from the side of the pillar; a row of props, five inches or more in the small end, are set under cap pieces and extend from roadway to roadway. Usually only four or five are used in each row, placed about four to five feet apart. These rows of props are put about every five feet. If necessary, of course more timber is used.

In breaking off rooms, they are started narrow from the level pillar, say six yards, and gradually widened until it reaches ten yards; the widening is done on one side, thus leaving one straight side from the level to face. When the rooms are started two roads, one alongside of each pillar, are used, but when the room is advanced some distance, to economise in the use of rails, a sweep is put in and at that point there is only a single road to the level.

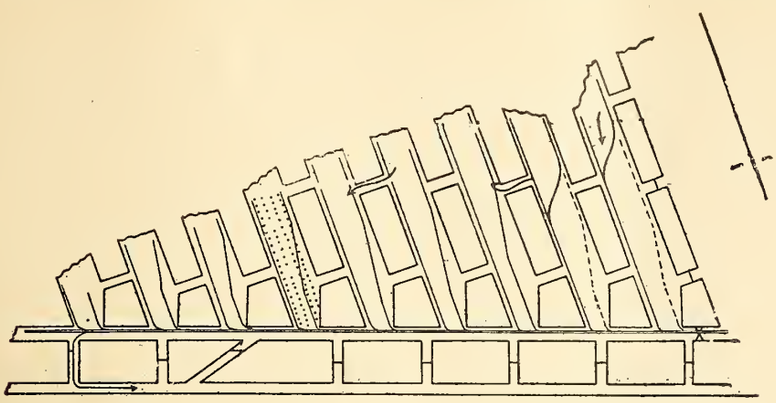
The coal is filled into boxes, containing from twenty-five hundred to thirty-five hundred pounds each, and the difference depends upon how the miner fills and heaps his tubs.

I trust that this brief description, together with the rough sketch, will enable everyone present to understand the very simple method of the wide room system adopted at the Gowrie mines.


Joggins Colliery, N.S.
Sketch showing part of the Longwall workings on the 1900 Level
and Sinking to 2300 ft. Nov. 26. 1892.
by James Baird.

MODIFICATION OF WORKING COAL IN NOVA SCOTIA.

Plate III.—Illustrating Paper by Mr. James Baird.



MODIFICATION OF WORKING COAL IN NOVA SCOTIA.

Plate IV.—Method of Working Wide Rooms at the Gowrie Mines, Cape Breton, illustrating Paper by Mr. Charles Archibald.

Notes on the Economic Minerals of New Brunswick.

By Wm. McInnes, of the Geological Survey of Canada.

In the following brief notes an attempt is made to gather together some of the facts relating to the economic minerals of New Brunswick, which are scattered through various publications. The principal sources of information have been the Annual Reports of the Geological Survey of Canada and the published papers of Dr. L. W. Bailey, of the University of New Brunswick. The paper has been writen, not with the idea of presenting anything new in connection with the subject but because it seemed desirable that the resources of New Brunswick, in the matter of economic minerals, should not be altogether passed over at a meeting of this sort, held in Canada. New Brunswick has always been rather an agricultural than a mining country and, in natural products, her wealth has been derived from her forests of pine and spruce rather than from her mineral resources. Now that the forests are yielding, each year with greater difficulty, a diminishing output of lumber, it is appropriate that attention be called to the known and possible mineral resources which may be looked to as future sources of wealth and revenue. A very large area in the central and northern part of the province, constituting its highlands has been but little explored, chiefly owing to its rugged character and remoteness from the ordinary highways of travel. Indeed of a large part of the district nothing is known beyond the valleys of its larger rivers and consequently of this area nothing can be said except that its possibilities are very grand and what little we do know of it points to conditions favorable enough for the occurrence in it of valuable minerals. We shall refer to the various minerals in alphabetical order rather than in order of their comparative importance.

Albertite—This very interesting mineral, though now, as far as known localities are concerned, exhausted, merits a passing notice both on account of its high pecuniary value and its, perhaps, unique mode of occurrence. At the time of its discovery near Hillsboro' Albert Co., in 1849, and for many years afterwards it was popularly looked upon as a true coal. As development work proceeded however and the nature of the mineral itself became, from more careful examination better understood, it became evident that neither in mode of occurrence nor in its nature did it merit the name of coal.

The bituminous shales which occur near the base of the lower carboniferous formation are rich in oil and from them, with little doubt, the petroleum which filled in the form of Albertite, veins and fissures in these and neighboring rocks, has been discovered. The principal vein which was worked to a depth of about 1,500 feet, was nearly vertical and presented all the phenomena of a crack or fissure which was subsequently filled with its contained mineral. Larger and smaller veins were found running off from it and these though sometimes following the lines of bedding of the strata, as frequently cut across them in oblique direction, as the forces which formed the original crevice determined. The mineral itself is black and shining and quite free from any signs of bedding. Its principal use has been as a gas producer mixed with coal of lower gas-producing qualities.

The Albertite yields about 14,500 cubic feet of gas per ton, or about 100 gallons of oil. It is estimated that 200,000 tons have been taken out at the Albert mine since the beginning of operations there, representing a value of probably more than three and a-half millions of dollars. Although exploration, with that object in view, has proved that veins of this mineral occur at various points widely separated along the band of lower carboniferous shales, yet these have nowhere been of sufficient thickness for profitable working. Before the closing of the Albert mine in 1879, every endeavor was made to locate other deposits in the vicinity but without result. The supply of Albertite may be said to be confined now to hand specimens for mineralogical cabinets.

Bituminous Shales—In this connection may be considered also the shales from which the last mineral has been derived. Though now practically quite out of the question as oil producers owing to the opening of the richer oil regions of the United States, Canada and other countries, they are perhaps from their permanency worth keeping in mind as possible sources of supply in the future. An attempt was made to work them before the opening of the Pennsylvania oil regions, and it was found that they yielded from 30 to 60 gallons of oil to the ton. The total amount of oil contained in these bands is very considerable when we know that they extend in length for about 50 miles and have an average width of about half a mile. The bands are very much twisted and bent and the strata are usually standing at very high angles. Petroleum has been noticed to ooze from these beds at various points, but never in sufficient quantity to warrant collecting it. Boring at various points has resulted only in showing oil in very small quantities.

Antimony—Antimony in the form of the grey sulphuret or stibnite with some native antimony occurs at Lake George in the parish of Prince William, York County. The locality is about eight or nine miles from the right bank of the St. John River and twenty-five miles from Fredericton. Veins of quartz scatter over a considerable area in this district, which cut hard argillites and felspathic sandstones of supposed cambro-silurian age, hold stibuite in greater or less quantities. The enclosing rock of the veins is altered by the probable near approach of intrusive granite which comes to the surface a short distance to the north. The thickness of the veins vary from a few inches to about six feet and the ore is irregularly distributed through them in strings which sometimes attain a thickness of 15 inches. On one of the properties in this neighborhood considerable mining work was done and plant consisting of an engine of 80 horse power, a steam drill, Blake crusher, jiggers, etc., was introduced and furnaces for smelting, etc., were erected. At first the ore was taken from open cuts along the surface of the vein, but later shafts were sunk and mining was carried on in a more systematic way. Work was discontinued about ten years ago and has not been resumed since.

Coal.—The only productive coal area in New Brunswick is that situated in Queen's County, about the head of Grand Lake, and limited quantities are mined here annually for local consumption and on a small scale for export. The product may be described as a bituminous coking coal giving a rather large percentage of ash. It is excellently adapted for blacksmiths' use and is used with satisfaction to the consumers as a house coal.

The result of a geological survey of the carboniferous area of New Brunswick has been to show that it is extremely probable that the beds referred to, which occupy such a large area in Queen's County, practically constitute the only seams of coal in the province which can be considered available for practical working. Other beds it is true have been found at various points, but where seen they are nowhere of any great thickness, and as they for the most part occur in what we believe to be the limestone grit, there does not seem to be any good reason to hope that thicker beds will be found. Borings too, though they have not been numerous enough to prove that the lower coal measures may not occur in depression in the underlying rocks, yet they do show that these lower beds are certainly wanting over all those areas where they have been made, and we are warranted in believing that their existence here at all is very doubtful and that if they do occur it can only be in troughs of very limited extent.

The large area covered by the seams which are now worked and their easy accessibility render them well worthy of consideration in reckoning up the available mineral resources of the province.

Though the exaggerated reports of the enormous value of these coal beds which were current some years ago have, with our increase in actual knowledge of the facts, been long discredited, yet there remains the knowledge that we have here a coal field easily accessible and capable of yielding a large amount of coal of good quality. The workable beds have been estimated to contain, if they keep about the same average thickness over the area, over 150,000,000 tons of coal.

Copper—Copper though occurring at many points in southern New Brunswick as a grey sulphuret scattered in lumps and grains through micaceous slates and other altered rocks, and in limited quantities in veins, has not as yet been successfully worked.

Almost all the ores of copper occur in limited quantities in New Brunswick, but none as yet noticed have been of a character which promised remunerative results.

Graphite—Graphite or Plumbago is found in a finely divided slate in many of the highly altered rocks of southern New Brunswick.

It has been found in considerable quantities in rocks of supposed Laurentian age near St. John and has been mined at the falls at the mouth of the St. John river. Mr. Hoffman analyzed a specimen from the locality and found it to contain:—

Graphite carbon	48·775
Rock matter	50·058
Hygroscopic water	1·167

Though this property is admirably situated for development it has never been very successfully worked owing probably to the graphite not being of a quality suitable for the manufacture of better grade lead pencils. There seems to be a good supply of the mineral and the deposit may yet be profitably worked.

Gypsum—Extensive beds of gypsum occur in the lower carboniferous of southern New Brunswick. The principal producing localities are Hillsboro and Hopewell Hill in Albert County. From these properties large quantities of gypsum both calcined and raw are annually shipped. The beds of gypsum attain a thickness of from 70 to 100 feet, though in some localities part of the bed consists of anhydrate, and cover an extensive tract of country.

These are associated with the limestones of the lower carboniferous and are for the most part white in color, exceedingly pure and of uniform character though differing in being highly crystalline in some localities and not at all so in others.

In the northern part of the province valuable beds of this mineral occur on the left bank of the Tobique River, about 30 miles from its mouth. The gypsum here occurs as in the southern part of the province associated with the limestones of the lower carboniferous. The beds attain a thickness of about 150 feet. It is made up of impure gypsum varying in color from dull purplish red to greenish, with thin layers which are pure white and fibrous.

Though for many years locally used by the farmers of the district and neighboring State of Maine, it has never been extensively shipped.

The opening of the Tobique Valley Railway will afford facilities for shipment which may extend its market and establish a profitable industry.

Gold—There have been from time to time reported discoveries of gold in various parts of the province, but none of the reported finds has yet led to any practical results.

That gold has been found in the drift at various points admits of little doubt, but whether this has been locally derived or not it is beyond our present knowledge to say. A possible source may be found in the gold of the Chaudiere district, carried down the valley of the St. Lawrence and thence southward with the ice which has scattered boulders of Laurentian gneiss over the lands south of the height of land.

In favor, however, of its local derivation we have the fact that a series of strata which strongly resembles the gold bearing series of Nova Scotia, and probably of the same age, crosses the central part of the province and over large areas, has been but little examined. Over the limited areas to which the densely wooded character of the region restricts detailed examination, these slates and sandstones are highly altered. Large areas of intrusive granite invade them at several points and they are in many places cut by numerous veins of quartz. These, as far as our present knowledge goes, are not auriferous. We may hope though that somewhere in the vast unexamined areas the veins may prove to be gold bearing.

Mr. Hinde has recorded washing gold from the depth of the Tobique and some of its tributaries, notably from a brook near Blue Mountain, and many other streams have yielded small amounts.

Iron—Attention was first called to the hematite beds of Carleton county, by Dr. Chas. T. Jackson, of Maine, in 1836. Though ores of iron have been noticed at different points throughout the province, these of Jacksonville above referred to, are the only ones which have been deemed promising enough to warrant development. The hematite here occurs, in association with limonite, in bands of varying width interbedded with green, red and black clay slates and can be traced for a long distance across the country. The containing slates form part of the great line of these rocks of silurian age which extends from this point northwards to, at one place, within nine miles of the St. Lawrence where they overlap the Cambrian of the so-called Quebec group. The thickness of the ore beds varies from a few feet to twelve or more and they conform to the plications of the enclosing slates which are much contorted. Though the beds when considered as a belt are continuous for long distances, as individual beds they often terminate almost abruptly. The dip is N.W. at an angle of 85 degs. to 90 degs. The ore everywhere holds a percentage of manganese and phosphoric acid the latter running in some cases so high as to render the iron cold short. An average of six analyses made by John Mitchell, of London, Eng., gave:—

Metallic iron	35·593
Sulphuric acid	·723
Phosphoric acid	1·298

An analysis of the pig by Mr. Wendt, M.E., gave :—

Phosphorous	1·032
Sulphur	·005
Manganese	3·460

These beds have been used for a number of years, the fuel used being hardwood charcoal, but active operations closed many years ago and it is extremely doubtful if, under existing conditions, they could again be profitably worked. Exploration along the strike of the beds though it has proved the continuance of the iron bearing band for some distance to the north-east and south-west has nowhere reached beds comparable to those of Jacksonville already described.

Bog Iron Ore—Deposits of bog iron ore are known to occur at various points in New Brunswick. One situated in the parish of Burton, Sunbury county, has been worked in connection with the hematite beds of Carleton county. The ore bed consists of a mixture of loamy and peaty material, with a depth of from one to three feet and underlaid by a clayey hard-pan. The ore is found in the form of cakes or loose feathered aggregations, few of them more than 6 to 12 inches in diameter although sometimes occuring as large as 2 to 3 feet. An intervale or alluvial terrace of considerable extent occurs here at a height of about ten or twelve feet above the St. John river and the ore bed occupies a longitudinal belt in it parallel to the river about 50 yards in width and three to four miles in length. The waters which have carried down and deposited the iron flow over rocks of millstone grit of middle carboniferous age and from these it has probably been derived in the first place.

Nickel occurs in pyrrhotite deposits in the county of Charlotte. The deposits are of pyrrhotite and chalcopyrite intimately mixed and closely resemble both in general aspect and, as far as I can learn from conversation with those who have visited the locality, in mode of occurrence, the nickeliferous pyrrhotite deposits of Sudbury. A sample of 72 lbs. weight, which was considered a fair average of the ore, was submitted to Mr. Hoffman of the Geological Survey of Canada, for analysis, and yielded 1.718 per cent. of nickel. As there appears to be extensive deposits of this pyrrhotite the analysis above quoted, though not showing a high percentage, would seem to warrant a more thorough examination of the region. The Sudbury ore is known to vary widely in the proportion of contained nickel and the occurrences here of deposits with percentage high enough for profitable working would seem to be not at all unlikely. As far as can be learned these, like the Sudbury deposits, are not veins, but rather aggregations of the mineral from surrounding strata in pockets and irregular masses at or near the contact of intrusive masses of the trap and altered sandstones and argillites of supposed Cambro-Silurian age.

A specimen from the vicinity of L'Etang in the same county, submitted to Mr. Hoffman for examination seemed to be of quite similar character.

Specimens from the first mentioned locality, which is within three miles of the town of St. Stephen, were examined by Mr. Best, of St. John, who says : "I have found as high as 2.48% of nickel at 19 feet from the surface in pit No. 2." Mr. Best further says :

"Samples were taken at about 17 feet from the surface and a New York chemist finds :

Sulphur	32·93
Iron	56·00
Copper	1·03
Nickel	2·04
Insoluble Matter	8·00

with traces of gold and silver."

Manganese.—The following notes are condensed largely from the annual report of the Division of Mineral Statistics and Mines of the Geological Survey Department for 1890.

The ores of manganese worked in New Brunswick are chiefly pyrolusite and manganite which occur in limestones near the base of the lower carboniferous formation. The ore is not found in veins, but in irregular beds and pockets, many of which are of considerable extent, as many as 4,000 tons have been extracted from one of these. Attention was first called to the value of these deposits in 1862, when Mr. Davidson, of St. John, commenced work in King's County, about 11 miles south of the town of Sussex. The ore up to a very recent date has been extracted entirely by open cuts and by drifting into the side of the hill. Exploration with the diamond drill has more recently revealed promising bodies of ore, and shafts are being sunk to gain these. Analyses of the Markhamville high class ore gave for three samples tested the following results :

	No. 1.	No. 2.	No. 3.
Manganese binoxide	89·70		
Manganese peroxide		97·21	96·62

with very small percentages of iron, barium, baryta and silver. A well equipped mill for treatment of the ore is in operation at the Markhamville property.

At Jordan Mountain about five miles north of Sussex a very similar deposit has been worked to a similar extent by open cutting and 400 tons or thereabouts of ore has been extracted.

At Quaco Head near St. Martin on the Bay of Fundy a tunnel has been driven into the perpendicular face of a bluff of calcareous shale, charged with manganite in scattered masses and pockets and a mill is in operation from which the ore after treatment can be readily shipped by water.

Analyses of the ore gave for the pure compact ore 58·20 per cent. of metallic manganese and of the porous ore 57·15 per cent.

In the parish of Elgin, Albert county, a decomposed quantity of supposed pre-Cambrian age has been found to hold manganite and pyrolusite, though whence it has been derived has not been determined. Work has been done on the property and an analysis of a specimen of psilomelane gave of manganese dioxide 50·21 per cent.

Operations were carried on for some years at Shepody Mountain, in Albert county on a deposit of pyrolusite and psilomelane occurring at the contact of the lower carboniferous strata which make up the mass of the mountain with the underlying older schists but the works have been long abandoned.

Extensive deposits of wad which analyses have shown to contain an average percentage of manganese binoxide of 47 per cent. are being worked in the parish of Hillsboro', Albert county. They attain a thickness in places of upwards of 40 feet and are covered by only a thin layer of partially decomposed vegetable matter. As the treatment necessary is extremely simple and inexpensive this ore should be extracted and worked at a good profit.

Salt—Salt has for a number of years been made from the brine obtained from natural springs in the vicinity of Sussex. Mr. Chalmers in the annual report of the Geological Survey, Vol. IV, page 91L, says :

"Brine springs occur at Sussex and Salina, King's County and at Bennets Brook, near Petit Codiac, Westmoreland County. The springs at Sussex are the only ones from which salt is now made. Five or six hundred bushels of salt per annum are manufactured here by the ordinary process of boiling the brine in pans..... The salt prepared at the Sussex Salt Work, is said to be of a very superior quality for dairy use ; but the sale is limited, the consumption being merely local. Several surface springs occur in the vicinity of these salt works, only a few of which have yet been utilized..... The brine at all these places contains a greater or less percentage of sulphate of lime or gypsum," and at page 41 A of the same report "a boring 125 feet deep was recently sunk at one of these springs 13 feet of it through surface deposits and 112 feet in rock. The object was to find the salt rock, but nothing of the kind was met with. The strength of the brine, I was informed, increased slightly till the solid rock was reached ; beyond that it did not perceptibly change."

Silver—Galena, carrying small percentages of silver, has been noticed in the province and some preliminary exploration work has been done on several veins, though none have yet been worked. Veins of this character are reported in the Negesigait River, Gloucester county, near Woodstock, Carleton county, and on the Tobique River, Victoria county.

The occurrence of tinstone in connection with the highly altered slates and gneisses of the southern part of Carleton county, where they are invaded by an intrusion of syenite, has been reported by Dr. Gesner by whom a specimen was collected and deposited in the Gesner Museum at St. John. The exact locality is not known but the occurrences of tinstone at Waterville, Me., in rocks of the same age, lends probability to the supposition that it may occur here.

Tripolite—Infusorial earth is known to occur in considerable deposits in many of the lake bottoms of southern New Brunswick. These seem to be of fresh water origin and contain numerous sponge spicules and quantities of broken up natimaceae. At Fitzgerald Lake, St. John county, a deposit of infusorial earth covers the lake basin to an estimated depth of about 50 feet, covering an area of about 60 acres. Besides making a good polishing powder, certain strata of this deposit have been used successfully for packing purposes as a non-conductor of heat.

Building Stone, etc.—To the list of known valuable minerals given we may add that the province can furnish in unlimited quantity a great variety of building stones of excellent quality. The sandstones, of carboniferous age, of Westmoreland and Northumberland counties have long been in good demand on account of their durability, color and good dressing qualities. Their use has not been confined to the province itself, but they have for years been extensively exported. In the same set of rocks occur grits or sandstones which make excellent grindstones.

The granites and syenites of the province too have been extensively quarried for local use and for export. Those of St. George, in Charlotte county, have become celebrated for their very beautiful tints, their uniformity of texture and their susceptibility to a high polish. Blocks and columns of very large size and free from flaws are readily obtainable and as almost any desired tint may be had they can hardly be surpassed for ornamental building purposes.

The granites at various points along the St. John River have also been extensively quarried, and those of the central granite area, though not widely used, furnish excellent stones.

Limestones are widely distributed and have long been profitably worked along the lower stretches of the St. John River, for building purposes and for calcining.

The Crawford Gold Mill.*

Capt. G. MacDuff, Waverley, N.S.

The history of the Crawford Mill is interesting considering the brief period since the patents were issued, showing as it does a patient and intelligent effort to accomplish a result long desired and of grave importance to the gold producers of the world.

Quietly and unostentatiously it has been developed, and as we believe, proved its ability to extract at one operation and at small cost a large proportion of all the gold contained in ores, whether the same be classed as free or refractory, and to dispense with the cumbrous, complicated and expensive apparatus now in use whether of a chemical or mechanical character, thus removing the absolute prohibition which at present exists to the successful working of many mines where after the free gold has been extracted a large amount of concentrates are produced which have to depend upon more expensive methods in order to recover the gold they contain.

The gentlemen who have secured the rights of the patentee for the United States and Canada, and are now introducing the mill for general use, are men of affairs, thoroughly conservative, and in no sense speculators, inventors or promoters, but are among those who estimate from a purely business point of view the care, time and expense necessary to establish solely upon its merits, a revolutionary process of this kind.

While fully recognizing the general attachment of certificated mining engineers to the use of stamps as a safe and sure means of recovering a considerable percentage of gold from its containing ore, and also recognizing the high intelligence which has developed the various chemical processes now in use for the same purpose, the Gold Extractor Company have avoided all antagonism or the issuing of advertisements or florid statements with regard to the mill or their belief in its power to extract the gold from raw ore or its products, but have patiently and steadily conducted such critical and exhaustive experiments as in their judgment was necessary to determine the merit of the mill as a gold extractor, and its endurance as a machine, before offering it generally to the public for sale.

While recognizing the general attachment of mining engineers to the use of stamps, it is by no means universal, and very grave questions are being raised by men prominent in the profession, on this subject. As an illustration of this I beg to quote from a paper read before the Institution of Mining and Metallurgy at the museum of Practical Geology, Jermyn St., London, S.W., on Wednesday, December 22nd, by the very eminent engineer, Mr. C. G. Warnford Lock, on Gold Amalgamation. Mr. Lock in the course of his remarks, says :—

"As to prevailing methods of effecting amalgamation, I venture to put forward the contentions that they are imperfect, that they are wrong in principle, and therefore cannot be perfected. To commence with battery amalgamation, I cannot find a single argument in its favor and I maintain that such amalgamation as does undoubtedly take place when mercury is fed into the mortar, happens in spite of, rather than by reason of the conditions presented, and always at the cost of efficiency in reduction which is the prime and only real duty of the battery. You cannot get two distinct and antagonistic operations out of one machine without detriment to both. This is surely a simple axiom. The effective capacity of the battery is curtailed to a most important extent by the discharge being retarded in order to give time for amalgamation, and by amalgamated plates occupying a portion of the never too abundant space which legitimately belongs to the screens. These evils will be the greater according as the reduction needs to be carried to a finer point so that it becomes greatest in those cases where the reduction process is most prolonged and most costly. Then there is the drawback that the mercury instead of being presented in a clean, substantial, and constant state, is broken up into the most minute particles, many of which must become inoperative, while all are exposed in a maximum degree to the injurious effects of decomposing sulphurets and other sources of contamination from the water. Unless the supply of mercury is much in excess of what the ore requires, amalgamation can only be very partial ; if an excess is provided, the waste must be all the greater. During milling operations the amalgamation is quite beyond control, and must proceed hap-hazard. Another drawback which has not been estimated is the evil influence of the metallic iron worn from the shoes and dies. The inconsistency of putting mercury into the battery is obvious. We lament the smallness of the gold particles, and the difficulty attendant on collecting them from the mass of pulp in which they are buried, and forthwith we take pains to smash up the mercury into tiny atoms also, ignoring the fact that in proportion as the globule of mercury becomes smaller its efficacy is diminished, and the risk of its escaping with any gold it may have picked up, is increased. To sum up the case of battery amalgamation, I submit that it must be condemned from both scientific and economic points of view."

The Gold Extractor Co., in furtherance of the general plan, have established and conducted for months, experimental metallurgical works in the city of New York, where they have received large and small quantities of ore from most of all the gold producing States of the United States, Canada and Mexico, and are now conducting experimental work on refractory ores in Virginia, North Carolina, Canada, Montana, and New Mexico, and will speedily have works in operation in Arizona and Oregon.

The information thus gained from these different tests and experiments is fully set forth in the circular now offered for your inspection, which we think establishes the claim that by the use of the Crawford mill, from 80 per cent. to 99 per cent. of the gold contained in the different ores can be extracted and saved in one operation, at less expense both of time and money, than can be accomplished by any other process now in use.

Briefly stated, we believe that one 12 inch Crawford mill, properly erected, supplied automatically with ore

* Paper presented at the International Mining Convention, Montreal.

reduced to about ¼ mesh, and supplied with clear water, will treat from 8 to 12 tons every 24 hours, and save the average of gold as mentioned above, which the ore contains, at a cost not exceeding $1.50 per ton, and will run continuously with very slight wear and tear.

If five mills are operated, the entire cost of milling, including wear and tear, will not exceed $1.00 per ton.

The per cent. saved, naturally varies with the character of the ore treated, whether the same be hard or soft, and also with the constituent elements of the ore, thus a larger amount of ordinary free milling ore can be treated in a given time than of a sulphureted ore, with a relatively varied per cent. of gold saved. The amount and character of these savings depending upon the speed with which the mill is driven, and the adjustment of the water supply. This, together with the accurate setting of the mill upon a firm and absolutely level foundation, constitutes essentially all the points for which an expert is required. When these points have been carefully considered and adjusted, the mill may be classed as automatic, and will only require the attendance of one person.

It has been found by experiment that the use of hot water in the mill is very advantageous, and that by its use the ore is more perfectly disintegrated, the action of the quick when heated is more pronounced, and hastens the amalgamation of the gold. Different modes for accomplishing this result may be used, varying with the surrounding conditions and the power employed to drive the machinery, whether it be water, steam or electricity. The engineer or superintendent in charge will readily determine the best mode by which the application of heat to the water can be made.

It is also proper to state that five mills, or the product from 50 tons every 24 hours, can be had as cheaply, so far as the cost of operating the mills are concerned, as from one mill, with the exception of the extra power required to drive the greater number of mills.

After the mills are adjusted and the speed and water pressure regulated, one man can properly wait upon five mills. An ordinary travelling derrick or crane, when in place, will open the mills easily and quickly, if from any cause the wearing parts require examination or renewal.

The item of ¼in. mesh is mentioned as being a suitable reduction of the ore to facilitate the action of the mill, while it may be determined that a still finer reduction may be found useful as experiments progress.

An able Engineer, in a late paper says: "At the outset we come to the question of the state in which gold occurs in nature. On this point there is some diversity of opinion, apparently due to different experimenters working on different ores. But if we admit that in some cases the gold is in chemical combination with tellurium, and perhaps also, with antimony, and that in other cases it may exist as a sulphide soluble in another sulphide, while in a third case it may be present as a chloride, associated with silver chloride, yet the sum of all these cases will give but a very small figure in comparison with the enormous number of instances in which it is only mechanically associated with the other ingredients of the mineral. It is in this predominating case of the gold being in a metallic state that the amalgamation process is applicable."

The Crawford mill is operated upon the belief that gold is not chemically but mechanically combined with other minerals. That being admitted, it may be worth consideration to reduce the ore before it is fed into the mill, to a much finer mesh, and thus increase its power of delivery.

This is essentially a mill for the extraction of gold, and while it does in effect extract a considerable portion of the silver which is often combined with the gold, it does not save all the silver in the amalgam, and when that metal is an important constituent in value of the ore, the residue passes over in the slimes, which may be panamalgamated, or treated by different methods that are now under consideration, both mechanical and chemical, either or both of which, it is believed, can be applied effectually and cheaply, and all the silver saved.

Many of the important facts regarding the Crawford mill are discussed in the circular now before you, hence I do not propose to weary you with a repetition, but refer you to the fact that results of primary importance have been obtained by the treatment of the Canadian ores with the Crawford mill, under the observation of gentlemen well known to be close critics of the highest character. It is possible that some of these gentlemen may be present, and if so, I shall cheerfully appeal to them for a confirmation of my conclusions as to its merits.

The Crawford mill has now been sufficiently tested and examined to warrant its presentation to all parties interested in mining gold ores. It will soon be in operation in the gold producing States of the Union, Canada, Mexico, and Central America, and probably will work a change in the amount of gold produced, as well as the value of the mines from which it is obtained.

It will not only, as we believe, make mines remunerative which are now abandoned, but it will provide the means for the profitable recovery of gold contained in the large deposits of tailings which have accumulated and in many instances remain, as a bequest from the use of stamps, ordinary mills, or chlorination.

Some facts relating to this latter process may be interesting, and while not offered for the purpose of depreciation or antagonism to a well known and much esteemed process for the recovery of gold, are presented from the official reports of the United States census recently published, in which the question of chlorination is ably discussed, and therefore may be worth consideration.

In that report the writer goes on to say, in the chapter on California, page 144, and speaking of the general use of chlorination in that State to obtain the gold from concentrates: "A chlorination plant with a capacity of six tons in 24 hours, costs from $6,000 to $7,000, and it will cost such a plant about $10 a ton to treat the concentrates. From 90 per cent. to 92 per cent. of the gold value of the concentrates is recovered. At all important mining points in California there are now custom chlorination works, which charge about $20 per ton for treatment, and guarantee about the above percentage of returns."

In the *Engineering and Mining Journal* of August 10th, 1889, quoted in the Census Report, page 143, appears the following:

"The chief objection to a plant of 50 tons or more capacity in 24 hours for the Plattner process, is the enormous size, and the length of time it requires to complete a single operation. The limit to the size would probably be a 50 ton capacity; when more is treated, another battery of tanks would be necessary."

Assuming these conclusions to be correct as to the cost of chlorination by the Plattner process, and that the article from the *Journal* is correct as to capacity, it may be useful to contrast the cost and results of treating the same amount of ore or concentrates by the Crawford mill; thus Plattner's process to treat 50 tons of ore every 24 hours, will require an expenditure for plant of $50,000, which can be treated at the mill at a cost of $10 per ton, equalling $500, and saving from 90 per cent. to 92 per cent. of gold.

Five 12 inch Crawford mills can be put in place, if the approach is at all reasonable, for the sum of $15,000, and will save the gold at a cost not exceeding $1.00 per ton, thus showing in favor of the Crawford mill $35,000 in cost of plant, and a saving in treatment of $450 on every 50 tons of ore treated.

It may be that the cost of a chlorination plant to handle 50 tons of ore daily, would be less in proportion than the same plant to handle six tons. Of this I can have no accurate means of judging, but as a general rule the cost of constructing any elaborate plant will exceed the estimate. But in regard to the Crawford mill there can be no mistake, if the place where it is to be located is in California and within 30 miles of a railroad station.

This contrast is made with the Plattner process for the reason that it is the favored and recognized process used in California, where the largest amount of gold now produced is subjected to the chlorination process. The cyanide or other process may be equally or more valuable, but I submit that in the main the same results would obtain.

In regard to the amount of gold which is obtained by the Plattner process, recently there has been occasion to treat a small amount of slimes sent to the metallurgical works in New York from a large chlorination establishment in Nevada, and the Crawford mill was still able to recover from one sample gold to the value of $8.27 per ton, and from the other $6.20, which had not been saved by the chlorination.

The quicksilver bath can be renewed at any time when necessary, without opening the mill or disturbing its operations, except for a very brief period.

The position which this bath of mercury occupies, and its method of operating upon the gold, constitutes an important factor in the economy of the mill. It is an essential element that pure water only should be brought in contact with the mercury. The mercury is not in any way ground up with the material, or brought in contact with deleterious elements which the ore may contain that would be calculated to sicken the mercury. It thus exercises its full power for amalgamation, and can be recovered with barely a trace of loss.

In discussing the question which the bath of mercury occupies, in the paper referred to, Mr. Lock remarks:

"It may appear to be necessary to lay stress upon the urgency of starting with clear and pure mercury, yet that is a point often overlooked. Moreover, on exposure to the air, the surface of the mercury will become oxidized sufficiently to hinder actual contact with the gold. Another important consideration which is apt to be lost sight of, is the value of having a good body and large surface of mercury.

When mercury is broken up into a number of tiny atoms the oxidation of the multiplied surfaces must be enormously hastened, and the efficiency thereby reduced. When the particles become very fine they are rendered actually valueless as amalgamators, and finally disappear in the tailings, especially in the presence of even small proportions of sulphide undergoing decomposition. Amalgamation is essentially a wet operation, and cannot be satisfactorily accomplished except in the presence of water. Hence it is of importance to secure water which is free from salts in solution and solids in suspension. Mine waters are especially bad on this account. In a low temperature amalgamation is sluggish, and, therefore, it is customary to supply heat in cold weather; but summer water is often much less pure than winter water, and decomposition of the sulphurets is more rapid in the presence of heat, so that these two conditions may combine to more than counteract the advantages of a genial climate."

The question of durability, or wear and tear, is very important, and has commanded the close attention and scrutiny of the engineers who have had this matter in charge, and while crucial experiments have not so far extended beyond four months, still we feel justified in saying that the wearing parts of the mill will not depreciate or require renewal as often, or to such an extent, as the same renewal or repair is required in any other existing process for the recovery of gold.

Only the best material is used for the wearing parts, and experiments which are now being conducted with chrome steel, have so far shown no perceptible wear and tear. Every effort has been made, and will continue to be made, to definitely settle this very important point, and we fully believe that the wear and tear, so far as the grinding parts are concerned, has been reduced to a minimum.

SECOND ANNUAL GENERAL MEETING

OF THE

Mining Society of Nova Scotia

At Halifax on 29th ulto.

The Second Annual General Meeting of the Mining Society of Nova Scotia, was held in the rooms of the Society, 129 Hollis Street, Halifax, on Wednesday, 29th March. Among others present were noticed: H. S. Poole, M.A., F.G.S., (Acadia Coal Co.), Stellarton, N.S.; John E. Hardman, S.B., M.E., Oldham, N.S.; Capt. Geo. MacDuff, Waverley, N.S.; A. A. Hayward, Waverley, N.S.; J. M. Reid, Oxford Mines, Musquodoboit, N.S.; C. E. Willis, Halifax; B. C. Wilson, Waverley; Chas. Archibald, Cow Bay; J. H. Austen, Halifax; W. G. Matheson, New Glasgow, N.S.; Wm. Smaill, Londonderry; R. G. E. Leckie, (Torbrook Iron Co.), Torbrook; Alfred Woodhouse, F.G.S., Montagu; Geoffrey Morrow, Halifax; G. E. Francklyn, (General Mining Association of London, Ltd.) Halifax; Duncan McDonald, Truro, N.S.; George W. Stuart, Truro, N.S.; T. R. Gue, Halifax; Alfred Dickman, Halifax; D. W. Robb, (Robb Engineering Co.) Amherst; Howard Clarke, Halifax; C. S. Harrington, Halifax; W. R. Thomas, Montagu; Dr. Gilpin, Deputy Commissioner of Mines, Halifax; W. H. Huggins, Halifax, and H. M. Wylde, Halifax, Secretary.

MR. H. S. POOLE, M.A., F.G.S., President, who occupied the chair, called the meeting to order at 10.30 a.m.

THE SECRETARY read the minutes of the regular Quarterly General Meeting, held in December, and of the special meeting held in Montreal during the sessions of the International Mining Convention.

MR. JOHN E. HARDMAN—It would be well to add to the minutes of the Montreal meeting that the Government had acceded to the request of the Society "that the Province of Nova Scotia should be represented at that meeting." The Government of Nova Scotia were perfectly willing that Dr. Gilpin should attend, but owing to pressure of business Dr. Gilpin could not get away, and as a matter of fact all the members who were present at Montreal know that the Premier, the Hon. Mr. Fielding, was present and represented Nova Scotia admirably. I beg to move that the minutes be amended in this respect, and that it be placed on record that the Government aceeded to our request.

On motion the amended minutes were approved.

The following names for membership were handed in: Mr. A. Drysdale, Mr. Graham Fraser, Dr. James McKay, Mr. Herbert Dixon and Mr. C. F. Andrews.

Upon motion of Mr. Willis, seconded by Mr. Chas. Archibald, these gentlemen were duly elected members.

THE PRESIDENT—The Council recommends, in regard to Volume I, Part I, of the Transactions, which has not yet been printed, that it be issued and embrace all that has been made public relating to the formation of the Society, including the notes in regard to coal legislation and matters relating to the agitation of a year ago. Will anyone move that the recommendation of the Council be adopted?

On motion of Mr. Hardman, seconded by Mr. Howard Clarke, the recommendation of the Council was adopted.

The Duty on Mining Machinery.

A letter from Mr. B. T. A. Bell, Secretary of the General Mining Association of the Province of Quebec, under date of 24th March, with reference to the Customs regulations relating to the imports of mining machinery was read.

THE PRESIDENT—The idea of the Council was that a committee should consider the matter and report at our next meeting.

MR. C. E. WILLIS—If there was any serious action taken on this subject and a list furnished the Department it might be the means of getting us into a bad trap. There are new machines being manufactured every day and if we furnish the Government with a statement, we might leave out these. This is a matter which should be looked into very carefully.

THE PRESIDENT—We could have on our committee such men as Mr. W. G. Matheson, of New Glasgow and Mr. D. W. Robb of Amherst, who are in a position to say what machinery was manufactured in Nova

Scotia. The list to be furnished the Government would only have to include such articles as can be supplied in this country.

MR. C. E. WILLIS—If we make a statement will the Department confine us to only these items which are contained in it?

THE PRESIDENT—The list would only show such as are manufactured in this country.

MR. W. G. MATHESON—The idea which I have got is this—not a list of articles that pay duty, but a list of articles that are *not* to pay duty, so that the statement would include any machinery made abroad.

MR. HOWARD CLARKE—I think the simplest way would be to make a list of what is manufactured in the Dominion, and have all other machinery admitted free. A list of what is manufactured here could be easily made out.

MR. JOHN HARDMAN—Let us make a list of what shall be charged duty and not a list of what is *not* charged duty.

MR. CHAS. ARCHIBALD—Would it not be possible for the Government to arrange with the different Collectors of Customs to pass machinery which was not manufactured in this country upon the party making a declaration to that effect?

THE PRESIDENT—That is the law now. You have got to make an affidavit that it is not manufactured in Canada.

MR. CHAS. ARCHIBALD—It would be a difficult thing to make a list of all that is made.

MR. JOS. AUSTEN—In making the affidavit under the law now, we not only have to state to the best of our knowledge and belief that the article is not made in Canada, but that it is Mining Machinery, and that it is to be used in a specified mine. That is the form of the affidavit we have to make.

MR. JOHN HARDMAN—This matter came up in the meeting of the Quebec Association in February. It was then stated that they did not get the same ruling from Collectors of Customs in the Province of Quebec, that we get from the Collector of Customs in Halifax. The Collector would not take their affidavit as to whether or not it was mining machinery, and the Quebec Association desired to have the interpretation of the law taken out of the officials hands.

MR. T. R. GUE—I think we would undertake a large contract to make a list specifying all kinds of dutiable mining machinery. I would make a suggestion that it is too far reaching to cover all. The President spoke of Mr. Matheson and Mr. Robb, whose business is making mining machinery quite largely—could they not specify what is made here, by themselves and others, and the Secretary could correspond with the manufacturers in British Columbia, Hamilton and elsewhere, and make a report? Of course such a report would cost them considerable time and trouble—but as those gentlemen are interested in the manufacture and sale of mining machinery in this Province, they could make such a list. The Government would scarcely question anything that the collector did who conferred with this committee. If you do anything else I am afraid it will not have the effect we want it to have, and will not be far reaching enough. These men are interested in the manufacture of mining machinery and they are not going to report for free entry upon machinery they can make here. If you put it on that ground I think you will get it in a shape the Government will not undertake to question. The things the committee recommend should be free. The only question is, are the gentlemen to be named willing to devote their time to making a complete list?—I think they will.

MR. J. M. REID—I have been importing machinery for the last two or three years, and I find a great deal of trouble getting it in, whether of a class manufactured in Canada or not, and several times I imported machinery not manufactured in Canada, which I did not succeed in getting in free of duty. If we can get up a list of what shall not come in free we have got a big contract before us, but if we get up a list of what shall come in free we have the list.

MR. JOHN HARDMAN—This is a matter which would be discussed much better in committee than by the whole Society; I move that the matter be referred to a committee to be appointed by the President.

MR. CLARK—I second the motion.

MR. J. M. REID—I wish to be placed on record against furnishing the Government with any list.

The motion upon being put was duly carried.

The Chair then appointed the following gentlemen to form the committee:

Messrs. T. R. Gue, Geoff. Morrow, Jos. Austen, D. W. Robb, W. G. Matheson and Duncan Macdonald, with power to add to their number.

Election of Officers.

THE SECRETARY—It would be well, in order to expedite business, that the Chair appoint a committee to take the nominations received, and report a slate suggesting the names of the officers and council for the ensuing year, as the first business of the afternoon session.

Upon motion duly passed the Chair appointed Mr. Smaill, Mr. Austen and the Secretary.

June Meeting, etc.

THE PRESIDENT said the Council hoped to be able to announce that the June meeting would take place in Pictou County, with excursions to the iron works, steel works and some of the collieries in that neighborhood. He then called upon Mr. W. G. Matheson to read his paper on Fuel Economy, regretting that the text of the paper had not been received in time to have it printed. Mr. W. G. Matheson then read a paper on the subject of Fuel Economy. A vote of thanks was duly tendered Mr. Matheson for his valuable paper, the President remarking that if the Society published no other paper in their *Transactions* for the year, members would get more than the value of their dues in the practical suggestions it contained. Discussion on the paper followed. This was followed by a paper by Mr. B. C. Wilson, entitled: "Notes on some special Features in Lode formation and deposition of Gold as presented in the Waverley Gold District." A vote of thanks to Mr. Wilson was passed, and the paper was discussed by members present.

The meeting then adjourned until 2.30 p.m.

Afternoon Session.

The members assembled in the rooms at 2.30 p.m.

A letter was read from Mr. J. R. Lithgow resigning his office as Treasurer to the Society. The resignation was accepted with regret.

Report of Council for Year 1892-93.

The following report of Council for the year 1892-3 was submitted and adopted.

The Council for the past year beg to submit the following report of what has been done by this Society during the past year.

The number of members who joined at the inception of the Society was 58, and other 17 members were elected during the year making a total of 75, of whom only three have resigned their membership.

Briefly stated the Society's income and expenditure during the past year has been as follows:—

Receipts—Balance received from Gold Miners Association in lieu of fees of 18 members of that Association...	$ 15 43
Subscriptions collected for 1892.....	487 75
Total.....	$553 18
Expenditure—As per Treasurer's Statement.....	$438 05

leaving a credit balance on 1892 account of $115.13. The subscriptions due and not yet paid amount to $25.00 of which $15 is placed as good and $10 as not collectable. The estimated income for the current year is $720.

Meetings—Since its organization the Society has held four regular meetings and one special meeting—and while referring to this, the Council desire to call attention to the very enjoyable quarterly meeting held at Londonderry on Sept. 7th and to the hospitable manner in which the members present, were entertained by Vice.-Pres. Leckie and staff of the Londonderry Iron Co. The special meeting was held at Montreal on Feby. 20th, on the occasion of the convention of the Mining Societies, when some 35 of our members were present.

Transactions—The Transactions for the year—Vol. I, include Part I (in press) on the formation of the Society and the petitions of lessees to the Governor General of Canada and the Lieutenant Governor of Nova Scotia respecting certain legislation of the Parliament of Nova Scotia affecting mining.

Part II—Contains a report of the first meeting of the Society and papers read by the following gentlemen:—

E. Gilpin, Jr., LL.D., F.R.S.C., on "Notes on Nova Scotia Iron Ores."

H. S. Poole, A.R.S.M., F.G.S., on "The introduction of new Explosives for coal getting in Nova Scotia."

J. S. McLennan, B.A., M.E., on "Changes in the Bank at the International Colliery."

J. E. Hardman, S.B., M.E., on "Recent Gold Milling Practice in Nova Scotia."

Part III—Contains a report of the second quarterly meeting held at Londonderry and papers read then.

R. G. Leckie, M.E., on "Roasting and Smelting plant at Londonderry Iron Works."

R. G. E. Leckie, C.E., on "Iron Deposits of Torbrook."

Wm. Smaill, on "Notes from Laboratory on some Iron ores from Nova Scotia."

Part IV is now in press and will contain a report of the December quarterly meeting and the special meeting held at Montreal in February.

Library—It is gratifying to the Council to be able to report that the nucleus of a library has been formed. The Society has some forty-five names on its exchange list, a considerable number of whom in return mail the Society their publications, and it is expected during the coming year that this number will be increased.

The Council would impress on members the desirability of collecting copies of all printed reports on mining properties in the province, even of those seemingly of no present value, with a view to keeping a record of the history and development of the industry. Where possible these might be supplemented by photographs of appliances and establishments.

Museum—The substantial collection of iron ores used to illustrate Mr. Smaill's paper read at the Londonderry meeting have been presented by him to the Society and are now on exhibition. It forms a valuable nucleus of what it is hoped will prove an attractive feature in the rooms of the Society, and the Council takes this opportunity to urge members to add to this collection by donating specimens of the various ores and minerals with which they have to do.

Quarters—Through the generosity of Mr. T. R. Gue, president of the Acadia Powder Company, a spacious room at 129 Hollis Street, in Halifax, has been fitted up and set apart for the use of the Society and it seems fitting to the Council to here also record the obligations of the Society to Mr. Gue in this respect.

Treasurer's Statement—The Treasurer's statement is respectfully submitted herewith.

President's Address.

MR. H. S. POOLE—When a year ago a general call to all engaged in mining in Nova Scotia brought together a goodly number of those interested both directly and indirectly, the most sanguine amongst us I cannot think anticipated the response that was then made and which it is my proud position to record to-day. The appeal touched a sympathetic chord in members of every branch of the profession, among quarrymen, among miners of gold, of coal and of iron, the moment was evidently opportune, and from adversity in the grasp of imposition sprang this society into being.

It had been felt before, but in a vague and general way, that organization for a proper consideration and due advancement of interests common to all branches of mining in this province was desirable, but the feeling found only a divided expression in the formation of local associations and temporary gatherings that met to consider, and perhaps expose, actions of adverse tendency, so that when the matter in question was settled, the cause for unanimity being satisfied, the several elements, but temporarily united, again fell apart. Heretofore protests have been made by individuals sometimes alone, sometimes with others against immature or ill-advised mining legislation, with what effect may be gathered on turning over the pages of the Statute Book and noting the amendments that have been made, and the self-evident contradictions that have remained recorded and unrepealed for years. At times modifications have been obtained and then the seekers, after decisive enactments, have dropped back to their ordinary avocations and unorganized condition; contract being broken the moral weight of a combination was lost, not only for a time, but weakened also when the combination was renewed, since experience anticipated it would be but temporary.

The under current of general interest that led to these local and spasmotic gatherings however failed to find unanimous expression until the experience of the mining men of Quebec,* the formation of the General Mining Association of that province under somewhat similar circumstances and the success which attended their appeal to the public for a careful hearing of their grievances made patent to all in like case in Nova Scotia that in union they might with good management and a just cause hope to stem the tide of imposition, gain the public attention and show the partiality that singled out the mining industry for restrictive legislation and the imposition of requirements not otherwise imposed on other industries.

The spark that at last lit the beacon possibly was that which fell from the Premier of the Province when he remarked to certain deputations that presented to the Government their isolated views on some proposed legislation, why do you not decide among yourselves as do other industries and present your case as a united expression, then the Governmeent will as far as possible meet your wishes. Perhaps it was this spark that caught the inflammable material in the loose sticks that hitherto individually had crossed each other and phantomlike from their ashes had bound them together into a bundle that it is hoped will long continue. At any rate when the call was made, the response was not halfhearted, the time was evidently ripe and lessees rallied to the watchword:—"Sanctity of Contract,

Fixity of Tenure and

Accuracy of Location."

Thus it was that the Mining Society of Nova Scotia took form and substance, and to-day we find ourselves organized with a membership numbering 75 and with representatives almost without exception of every company engaged in active operation.

Nor can it be overlooked how much this Society is indebted to its local forerunners the Coal Owners Associations of Cape Breton and Pictou Counties, and above all to the Gold Miners Association which during the four years preceding its amalgamation with this Society did so much for its members and by joint representation affected so many changes in that part of the chapter "Of Mines and Minerals" relating to gold mining that of these matters they were fully justified in expressing satisfaction for the consideration received at the hands of the present administration. What the changes were that were effected I trust to see fully recorded in our Transactions. Already we see a new organization profiting by the experience the old lessees so rudely acquired last winter. The Whitney Syndicate which has since became the chartered Dominion Coal Company is indebted to this Society for making clear to them the desirability of having in their lease a right to appeal to the Courts for settlement of disputes which may turn on the meaning of the wording in their leases. This has been acquired. What in substance the old lessees said last winter was:—Place us in the position of John Doe in dispute with Richard Doe over the legal meaning of our Indenture, let the courts decide and it will effectually stop all the talk about home and foreign capital having been misled into believing the sacred name of Her Majesty is used in the leases as typical of good faith, and the implications that the sanctity of contract has been violated when the *power* of the Legislature to convert "might" into "right" has been invoked, the Legislature being, as a landlord in the case

* CANADIAN MINING REVIEW, July, 1891.

in question an interested party. This right of going into court the old lessees have not as yet been granted.

Elsewhere I have drawn to your notice the incongruities which mark the legislation respecting the working and regulation of mines and their probable cause, by other of our members it is expected the remaining portions of the legislation included in both the chapters that deal with the leasing and working of mines will be reviewed. These matters of undoubted moment to our Society will, it is hoped, before long cease to be active questions, and that then our individual attention can be given to reporting and discussing the many improvements and modifications which the rapid advances in the devices and arts place at the service of the miner. Our gold miners have no cause to fear competition in their business and do not object to share with others the benefits derived from changes in mining and milling practices; our coal members feel that when they have introduced an improvement in their pits they will not long be able to keep it hidden from their fellows and therefore that they may as well openly talk of it and get any credit there may be due for its introduction; while those of us who have met with disasters need not think our blunders or misfortunes will pass uncriticized because we ourselves say nothing about them, so we may as well make a virtue of necessity and point out if we can to others the way to avoid the pitfalls into which we have tumbled.

I would especially urge on members the advantage of having their papers for the quarterly meetings prepared well beforehand, and remind them there is a wide range of subjects and material open to them. Long papers are not necessarily asked for, concise statements of facts of which the writer is thoroughly conversant are preferred. The history of early mining practices in this country is of interest, while the more rapid developments of late years open fields that will extend as time rolls on and change succeeds change in methods of working, in facilities for production and transportation, and in substituting mechanical power for the more arduous manual labor.

Election of Officers.

The officers for the ensuing year were elected as follows:

President—H. S. Poole, F.G.S., general manager Acadia Coal Company, Ltd., Stellarton, N.S.
1st Vice-President—John E. Hardman, M.E., S.B., Oldham, N.S., manager Oldham Gold Company, and West Waverley Gold Company.
2nd Vice-President—R. G. Leckie, general manager Londonderry Iron Co., Ltd., Londonderry, N.S.
3rd Vice-President—David McKeen, M.P., Glace Bay, C.B., resident manager Dominion Coal Co., Ltd.
Treasurer—T. R. Gue, Halifax, N.S.
Secretary—H. M. Wylde, Halifax, N.S.

Council:

Charles Archibald, North Sydney, C.B.
R. H. Brown, Sydney Mines, C.B.
Charles Fergie, M.E., Westville, N.S.
Graham Fraser, New Glasgow, N.S.
E. Sjostedt, Bridgeville, N.S.
D. W. Robb, Amherst, N.S.
B. C. Wilson, Waverley, N.S.
George W. Stuart, Turo, N.S.
Joseph H. Austen, Halifax, N.S.

In the evening the Society held its annual dinner at the Halifax hotel. The *menu* did credit to host Hesslein, and was thoroughly discussed by the large number of members and guests in attendance. Mr. H. S. Poole, of Stellarton, the president, occupied the chair, and on his right and left respectively were Hon. Premier Fielding and Hon. Attorney-General Longley. Mr. J. E. Hardman, of Oldham, occupied the vice-chair. The first toast was "The Queen," proposed by the chairman. This was followed by "The sanctity of contracts," which was given with a ritual and highly enjoyed. Mr. Hardman proposed "The Government of Nova Scotia," to which Hon. Mr. Fielding responded. "Politics and Mining as a Fine Art," proposed by Mr. Poole, was responded to by Hon. Mr. Longley. Mr. Drysdale responded to "The Legal Fraternity," and Messrs. Harrington and Dickman to "Our Guests." Various other toasts were honored and among the speakers were Mr. T. R. Gue and Dr. McKay, of Truro. Songs were indulged in and everything passed off in a very pleasant manner.

British Columbia Colliery Returns for year 1892.

Company.	Total Output to 31st Dec., 1892.	Quantity Exported.	Sold for Home Consumption.	Labor Employed.
	Tons.	Tons.	Tons.	
New Vancouver Coal Mining & Land Co. Ltd.	433,386	307,623	130,029	1,367
Wellington Colliery Co..	290,370	238,400	56,862	815
East Wellington Coal Co.	33,650	28,000	5,350	152
Union Colliery Co.....	68,928	66,556	4,782	520
Kamloops Coal Co.....	Being	opened.	.....	8
Total	826,335	640,579	196,224	2,862

MINERAL REVENUE OF NOVA SCOVIA, 1892.

Amounts received from various sources as revenue by the Department of Mines for the year 1892, also showing a comparison with 1891.

SOURCE.	Year 1891.	Year 1892.	Increase of 1892 over 1891.	Decrease of 1892 with 1891.
Prospecting Licenses	$10,133 37	$7,371 98	.....	$2,761 39
Rents (Gold Lease Applications)	1,622 00	1,926 00	$304 00	.....
Gold Rentals	1,409 50	1,653 50	244 00	.....
" Royalty	8,360 49	8,199 42	.....	161 07
Licenses to Search—Minerals other than Gold and Silver	4,340 00	5,040 00	700 00	.....
" Work and Leases, " " " ...	1,600 00	1,925 00	325 00	.....
Rentals— " " "	2,400 00	3,030 00	630 00	.....
Iron Royalty	.....	180 50	180 50	.....
Coal "	143,572 10	135,962 80	.....	7,609 30
Fees, for Searchers, Registrations, etc	215 50	408 10	192 60	.....
	$173,652 96	$165,697 30	$2,576 10	$10,531 76

Memo. showing the amounts received from the undernamed sources) in connection with the gold product), by the Department of Mines during years 1891 and 1892, from counties mentioned herewith.

Prospecting Licenses.

	1891	1892
Yarmouth	$127 50	$158 63
Cumberland	179 00	10 00
Victoria	351 01	341 77
King's	575 00	2 00
Queen's	1,185 18	793 64
Guysborough	1,259 89	1,892 19
Hants	1,457 01	419 74
Lunenburg	1,534 62	870 31
Halifax	1,541 73	2,375 21
Colchester	1,633 05	367 01
Other Counties	289 38	141 48
	$10,133 37	$7,371 98

Rents (Gold Leases).

	1891	1892
Victoria	$48 00	$91 00
Lunenburg	128 00	136 00
Colchester	142 00	14 00
Queen's	142 00	92 00
Hants	196 00	154 00
Guysborough	380 00	897 00
Halifax	578 00	540 00
Other Counties	8 00	2 00
	$1,622 00	$1,926 00

Gold Rentals (Yearly Payments on Leases).

	1891	1892
Yarmouth	$33 00	$27 00
Queen's	189 00	175 50
Lunenburg	195 00	176 00
Colchester	202 50	116 00
Hants	206 50	324 50
Guysborough	236 50	313 00
Halifax	347 00	513 00
Other Counties	.....	8 50
	$1409 50	$1,653 50

Royalty on Gold.

	1891.	1892.
Colchester	$ 6 39	$ .....
Lunenburg	9 87	4 53
Guysborough	527 42	1,073 23
Hants	1,239 72	1,157 41
Queens	2,195 69	1,281 77
Halifax	4,381 40	4,657 08
Yarmouth	.....	25 40
	$8,360 49	$8,199 42

Memo. showing amounts received by the Department of Mines, Nova Scotia, during years 1891 and 1892, from various sources in connection with Minerals other than Gold and Silver, in undernamed counties:

Licenses to Search.

	1891.	1892.
Cape Breton	$1,470 00	$ 1,590 00
Cumberland	570 00	750 00
Pictou	470 00	780 00
Inverness	420 00	510 00
Antigonish	120 00	120 00
Richmond	420 00	210 00
Yarmouth	.....	60 00
Hants, Lunenburg, Annapolis, Colchester, Digby, Victoria, Kings, Guysborough and Halifax	870 00	1,020 00
	$4,340 00	$5,040 00

Licenses to Work and Leases.

	1891.	1892.
Cumberland	$ 425 00	$ 1,025 00
Cape Breton	450 00	450 00
Pictou	375 00	75 00
Inverness	125 00	125 00
Guysborough, Victoria, Antigonish, Colchester, Richmond, and Hants	225 00	250 00
	$1,600 00	$1,925 00

Rentals—Minerals other than Gold and Silver.

	1891.	1882.
Pictou	$ 570 00	$ 750 00
Cumberland	840 00	810 00
Cape Breton	690 00	990 00
Colchester	60 00	90 00
Other Counties	240 00	390 00
	$2,400 00	$3,030 00

Coal Royalties.

	1891.	1892.
Cape Breton	$ 74,406 88	$87,994 68
Cumberland	43,042 17	20,696 54
Pictou	26,111 80	27,235 68
Other Counties	11 25	35 90
	$143,572 10	$135,962 80

Iron Royalty.

Received during 1892, from John Cameron, Esq., of East River, Pictou County, being the first Royalty from Iron received by the Department of Mines.. ..... $180 50

W. H. Browne,
Chief Clerk and Accountant,
Dept. Public Works and Mines.

Halifax, N.S., March 27th, 1893.

Notes of a Visit to Vancouver Island and its Coal Fields.

By James Ormiston, M.E.*

The Canadian province called British Columbia is a land of which little comparatively is known. It lies far from our country, out in the far West, and cannot be reached except by a long journey over sea and land.

For the traveller, it is a land of surpassing interest, but its time, perhaps, has not arrived yet for the settler who seeks to cultivate the soil. Fishermen and woodmen, and those who hunt the fur bearing animals, find in it a better field for their pursuits. The miners, too—colliers and gold diggers both—find occupation there; and of late the country seems to have been giving the promise of silver in great abundance stored up in its mountains.

Vancouver Island, named after the sailor who was amongst the first to navigate the waters there, forms a part of the province. It lies out in the Pacific Ocean, separated from the mainland portion of the province by the Straits of Georgia. In size it is about half the area of Scotland. In appearance it has all the natural features common to the whole of the land west of the Rocky Mountains. Nature has ploughed the earth there with deep furrows and lofty ridges, and scattered broadcast over all a crop of giant pines.

The capital of the province, the interesting little town of Victoria, is situated at the south end of Vancouver Island. Its population is about 25,000 in all, and it forms the centre of life and activity for the province. It is easily reached from the terminus of the Canadian

*Transactions Mining Institute of Scotland.

Pacific Railway on the mainland opposite, there being regular steamer communication across the dividing Straits of Georgia.

From Victoria there is a railway—the only public railway of the Island—and this railway connects the capital with the principal coal fields of Vancouver Island. The distance by rail to these coal fields is fully seventy miles.

The ride along this railway gives to the stranger a good idea of how the settlement of a new country proceeds. The track has been cut almost throughout its entire length in the virgin forest, and every now and again the train pulls up at a little clearing where the settlers are hard at work cutting down and burning up as useless lumber many a splendid giant of the forest. A few wooden houses, the dwellings of the settlers, are seen clustered together, a cheerful break in the gloomy monotony of the forest, and some few, but very few cultivated fields, reclaimed after many a hard day's work of patient grubbing amongst the great pine tree roots. These are the promises of life and growth amongst the youthful settlements.

The railway line terminates at the chief coal fields of the Island. The mining capital of that region, its Wishaw or Hamilton, has grown up here amongst the coal pits. The name of this town is Nanaimo (pronounced Nan-eye-mo). It has a population of seven or eight thousand, and out there where population is so scarce it is called a city.

The little city presents a remarkable contrast to the mining towns of similar size with which we are familiar at home—a contrast, it must be said, very much in its favor. Imagine a situation somewhat resembling that of Brodick or Lamlash on our own Firth of Clyde, a sunny slope looking out on the bright waters of a sheltered arm of the sea; behind this slope a high hill; and away in front, across the waters, an array of lofty mountains, the great range of the Cascades, stretched out as far as the eye can see, both north and south, their summits white with snow, and showing clear and bold against the sky, in a line fretted by many a strange curve and peak. Scattered over the waters of this arm of the sea are to be seen, also, many islands with their pine tree covering showing like a dark green mantle down to the very water line.

Although a land of coal, the sky is still clear and the air is pure, and the men who live there are free as yet from the depressing effects of the murky and grimy surroundings of our coal regions here.

The town itself is hardly in keeping with its surroundings, so far as fine palatial buildings are concerned, but as a collection of dwellings of working miners it presents a far more pleasing spectacle than anything of the kind to be seen at home.

Wood is the great material here for structures of all kinds, from lofty and elaborate churches to the rough shanties of the Indians; and for the same outlay as on a stone or brick dwelling at home, one may have twice the accommodation out there in a wooden structure, with a very presentable outside appearance, and a very fair degree of comfort inside as well.

Land, also, being of course plentiful and cheap, the houses are built for the most part each one by itself on its own plot of ground, and the unpicturesque colliers' row so familiar to us all at home has no place out there.

Some very imposing looking houses, too big, it might be, for the colliery manager at home—more the colliery owner's kind of house, perhaps—were pointed out to the writer as the property and dwellings of workingmen, and were said to have been built entirely "off the pick point."

Behind and on each side of the little town lies the deep gloomy forest, the home of panthers, bears and other wild animals. Deer, too, are plentiful in these forests, and venison is too common to be reckoned much of a delicacy.

Every miner owns a rifle, and shooting excursions in the forest are too easily had to be thought of much account.

The town has a mixed population. Our own countrymen are well to the front as usual, and the writer had more than once a hearty greeting from mining men he either knew personally in the old country, or of whose people he had some acquaintance.

Life amongst the miners seems to know something more of the holiday side than amongst the same class at home, if one may judge from the means of amusement and recreation which are at hand. Pleasure boats, driving "buggies" and places of entertainment for the public are all more plentiful than one would look for from the size of the place. "Money is round and was made to roll," might be the motto of the bulk of the people. Pleasanter surroundings and a greater freedom from the nightmare of possible want seem to make them take life less sadly than at home.

The little community here has had, too, its own black times. In the cemetery behind the town one may read on the tombstones those tales of disastrous explosions in the mines, which we know of too well at home. On two occasions, a few years back, many lives had been lost in this way in the coal mines.

Measured by our home standards of population and production, Nanaimo and its mines would fill a very small corner, but to the British Columbian they have a name and fame which sound even to the far east of the wide Dominion of Canada. The visitor can be told with pride of a wandering Scot, a collier, who was making his way there, but whose tongue had somewhat lost grip of the name long before his journey had ended. All he could say was that he had come "tae houk coals at a place wi a name that soonded like My-Nannieo." He required to say no more. He was set right at once, and passed on to to the proper place.

Taking up matters more technical, some idea might be given first to the extent of the island coal-fields. Information on this point is by no means abundant, but certain areas have come to be mapped out in a way.

Nanaimo town is within a few miles of the southern or southeastern extremity of the field. To the north, or northwest, the field extends up by the coast for at least ninety or one hundred miles. It may extend further, but this has not yet been proved. The average width of the field is not more, perhaps than four or five miles, measured from the sea coast to the outcrop line inland.

This area has been tapped at two places, Nanaimo and neighborhood, and the Comox district, some fifty to sixty miles up the coast above Nanaimo.

The total output for the year 1891 was about one million tons, eighty per cent. or so of the whole being raised at the Nanaimo end of the field.

The age of the deposits is supposed to be cretaceous, and it needs but a slight examination of the coal-bearing strata to discover marked differences in their character, and also in their position with regard to the non-coal-bearing rocks, when compared with the older deposits of our own country. The base or floor of these coal measures is a hard igneous rock, like our whin or trap, of unknown thickness The workable beds of coal are found near the floor; indeed, the lowest seam is said to be found at times resting on the trap with nothing at all between.

In boring to prove the seams this floor becomes the index of position. The igneous rock once struck, the borer knows he need go no deeper, for sheeted whin or trap interleaved with the strata does not seem to be found there at all.

Only two seams are worked as yet, and these lie not many fathoms apart, the distance being variable, Shaley strata, with some nodular beds of clay ironstone, fill in the tale of the measures about the coals. Sandstone and shales alternately come in above, and a great thickness of these, several thousands of feet possibly, can be traced to the dip, seawards, on the islands which lie at varying distances off the shore. All these upper strata appear to be barren of workable coal. The only productive measures are those nearest the trap floor.

A distinctive rock, well known to the mining men there, is found overlying the workable coals. This rock is a conglomerate, the pebbles in it being about the size of small marbles. In thickness it seems to be very variable, changing often in part to an ordinary sandstone.

The two coal seams worked at present are of a varying thickness. It may not be very wide of the mark to give to them both an average of about five feet each of clean coal.

Shafts and ingoing eyes are both in use for working these seams.

The deepest shaft is one lately sunk on a small island out in the harbor at Nanaimo. This shaft tapped the lowest workable seam at a depth of one hundred and twenty fathoms, and a well equipped colliery, capable of raising a large output, is now in process of completion at that spot.

In the methods of working the coal there does not seem much to call for special remark. Neither water nor firedamp appears to give them so much trouble as at home. The two bad explosions referred to were more likely due to coal dust than to gas. A very elaborate system of water pipes is in use at one colliery now to lay the dust and lessen the risk of explosion from this source.

At one of the mines electrical coal cutters are being tried, and at another electrical locomotives for haulage underground. In neither case, however, had there been a sufficiently long trial to enable much to be said about them. This indicates, however, that even in the farthest West the use of electricity is pushing its way.

The quality of the coal is not so good as that of our home coal. The ash runs up to about double the amount of that of our average quality of coals, and the fixed carbon for the most part runs too low to make a very good steam coal. At the Union mines, in the Comox district, the coal is in some respects better than at Nanaimo, the ash is perhaps no lower, but the fixed carbon is higher, and the caking property is much better developed there than in the Nanaimo coal.

Good firm coke was being made in an experimental oven from the washed small of this Comox coal. The ash of this coke, however, would be too high to enable it to hold its own very successfully with such a coke as that of Durham or Pennsylvania, it being about 18 per cent. in quantity.

The nearness of great bodies of igneous rock to the coal seams does not seem to be accompanied here by the same charring or burning of the coal as we find at home.

At no place does anthracite or blind coal seem to have been found on the Island, not even where the coal has the trap rock for a pavement. One naturally infers from this that these sedimentary coal bearing rocks, with their coal seams as well, had been washed down and deposited on the trap rock floor after the latter had become cooled down. The variations observable in the fixed carbon of the coals are possibly due to varying pressures, either lateral or superincumbent. The Comox coal has the highest fixed carbon, and the mines there are close to a high mountain range; an upheaval probably dating long after the coal seams had been deposited. This upheaval may have produced a lateral pressure sufficient to work the change in the character of the coal, as pressure and direct heating appear in many cases to be followed by the same results. Round Nanaimo, on the other hand, there is a comparatively large area of the coal field beneath a plain more or less flat and at some little distance from the hills.

Coal deposits thought to be of similar age to those of Vancouver Island have been discovered in the Queen Charlotte group of islands, about 150 miles to the northwest. Some of this coal is reported to have been found in the anthracite condition. The writer was shown one specimen from there supposed to be anthracite coal. A simple blowpipe test, however, showed it to be a piece of obsidian or natural glass, a volcanic product destitute of carbon, but possessed of a fracture black and lustrous, not unlike that of anthracite coal.

The north end of Vancouver Island has shown signs of coal, indeed a small quantity was worked there many years ago; but the seams found there were two thin for profitable working. The district, however, has been having renewed attention from coal prospectors of late.

The interior of the Island is almost entirely an unknown land as yet. This may sound strange to people at home, but it will not be a matter of much surprise to the man who knows something of the dense forests of that region. The Island is one great forert, and a march of a few miles in this forest where no trail has been made will prove a good day's work for a strong man.

It is something curious to note the remarkable persistency of growth in these great pines, even in the most unlikely spots.

The crests of the mountain ranges six thousand or seven thousand feet high, show a bristling line of pine trees against the sky, and from these crests down to the water's edge at the sea line, there stretches out one dark green forest sheet, broken only, it may be, by the gorges of the rivers or the smooth shining surface of the mountain lakes.

The great Douglas pine, the commonest tree of these forests, has a height more often, perhaps, over than under 150 feet, and very often it is much over 200 feet. The cedar, too, of these forests is another great giant. This is the tree the Indians choose for their dug out canoes. One of their large family or tribal canoes, seen by the writer and roughly measured by him, would be somewhere about forty or fifty feet in length, by about six feet beam, cut out of a single cedar trunk.

These Indians, the original lords of all these lands, form a subject of much interest to the traveller. In the earlier days of the coal mining their labor was in use at the mines, even for underground work, but now they are all back to their original work of fishing and the cultivation of their little gardens.

For work at the mines, the yellow-skinned man from the other side of the Pacific Ocean has appeared on the scene, and he has driven the Indian out of the field. Large numbers of these Orientals—Chinese and Japanese both, but particularly Chinese—are employed for nearly all kinds of work at the mines.

It looks rather peculiar, at first, to see these pig-tailed fellows tipping up hutches and doing all the work about a busy pit-head as expertly as if they had never done anything else in their lives. More peculiar still, perhaps, to meet them underground, handling with perfect skill all the tools of the collier.

The manager of one of the mines, a Lanarkshire man, spoke well of the Chinaman as a good all round colliery man, and both biddable and reliable to the bargain.

The Provincial Legislature of British Columbia some time ago passed an act to exclude the Chinese from all work underground, but for some reason this Act has not been enforced. A case of infringement of the Act had been attempted to be raised, the writer was informed, but it broke down, and the alleged reason for the break down was rather remarkable. The Chinamen accused of breach of the Act pled not guilty, and this was not on the score that they hadn't been working underground, but from the fact that they weren't Chinamen at all. They came from Hong Kong, they said, and were goods subjects of Queen Victoria. Hong Kong being a British possession, and the tracing of a Chinaman's genealogy and birthplace being a "kittle" job for a Western man to tackle, it seems little wonder that the case for the prosecution after this was left alone.

But the Chinaman's presence out there, it is to be feared, gives to the workingmen of our own race, rightly or wrongly, much occasion to blaspheme. From no other country under the sun could such competitors for the work of the white laboring man be drawn as from China. Viewed as a mere engine to effect a cheaper production, the Chinaman, when skilfully directed, may wel be a terror to the manual workers of any other race. We are hearing much in these days of the doctrine that every penny of our wealth is the creation solely and entirely of the class which supplies the manual labor. Should the discord between classes, due to the preaching of this doctrine, ever unhappily lead to extremes, the Chinamen in that case may prove an object lesson to help on a somewhat modified belief in the doctrine. China, roused from slumber and ready to join western skill and western capital to her own vast resources, might work many a queer change under free trade in the industrial world.

Meantime, however, one may note with interest how the Chinaman can calmly take his place beside the white workman heedless of all opposition so long as it takes not the shape of physical violence, and how, while imitating closely his white brother in all that pertains to the work in hand, his imitation sharply ceases when this work is done. He becomes the elder brother then in all other respects, conscious of superiority, differing in this matter from that docile child of the human race, the African negro, with a difference wide as the poles.

Quite a considerable proportion of the whole work of the coal mines out there is done by Chinamen, and unless the present poll tax is increased this proportion will doubtless grow larger. White labor of all kinds is very highly paid, more than double the home scale in many cases.

The cost of living, so far as food goes, does not differ

much from the home cost. Housing, in the sight of wooden buildings, will be even less in its cost than at home. Clothing of course is higher, as it must be brought either from the old country or from the distant provinces of eastern Canada.

The man who wishes to live economically out there would require, however, to do with as little as possible in the way of service from people of the white races. The Chinaman has been sharp enough to see his opportunity here, and has established himself as the general laundryman, cook, and even housemaid of the community.

As illustrating in one small item how the personal services of the white man must be paid, the writer may mention his having to pay in Nanaimo the sum of two shillings for the simple ten minutes service of the hairdresser.

The climate of Vancouver Island is very pleasant. The summers are brighter and warmer than with us, and the winters don't appear to be any colder. Plenty of rain no doubt falls, but the proportion of bright sunshiny days appears to be much higher than ours. Altogether, for climate and scenery, it is such a land as the man of this country is likely to find pleasant and agreeable.

The future prospects of the coal mining of the island have had no notice; perhaps something said on this point will be of interest.

The area of coal-field already proved is considerable, and it may be that as the island is better explored other areas will be found. In any case, there seems to be coal-field enough to supply the demand for a long time to come.

The demand at present is mainly from San Francisco, the chief city of the whole Pacific coast of North America.

San Francisco draws a fuel supply from countries widely scattered. Australia supplies a large quantity, and so does our own country. When the outward freights of the port are tempting enough, sailing ships in large numbers, carrying coal at nominal freight, come from round the Horn and from the Southern Pacific, and then San Francisco becomes flooded with cheap coal, of a better kind, too, than any mined on the Pacific coast. These are bad times then for Nanaimo, and they appear to come too, rather frequently. Still, leaving this out of account, the Vancouver coal seems able to do more than hold its own with any other coals raised on the Pacific coast. In the State of Washington, to the south, a good deal of coal mining is carried on amongst deposits which appear to be a continuation of those of Vancouver Island, but this coal for the most part seems to have more of the lignite character than any other.

The market is bound to grow as population grows; and as iron ore seems so be abundant also, it may be that a local iron trade will come in by and by to increase the local demand for coal.

One remarkable feature of this region is the great extent of country opened up both in Vancouver and on the mainland by canal-like arms of the sea, deep enough to float the biggest ships. Both the coal and the iron ore deposits and, it may be added, great limestone deposits as well, are all convenient to these deep water channels. Some day these channels will doubtless play an important part in the ready in gathering of produce of all kinds.

CANADIAN COMPANIES.

The Van Winkle Consolidated Hydraulic Mining Co.—The annual general meeting of the Van Winkle Consolidated Hydraulic Mining Company, Limited, was held on 4th instant at the Company's office, Vancouver, the President Mr. R. G. Tatlow occupying the chair. The following report on the operations at the Company's mining locations was presented by the President:

VANCOUVER, April 4th, 1893.

To the Shareholders Van Winkle Consolidated Hydraulic Mining Co., Ltd.

GENTLEMEN,—It must be a matter of greatest disappointment to you as it is to your Directors that, owing to the exceptional, I may say almost unprecedented, lateness and severity of the season, active operations have not yet been commenced upon the Company's Mining locations. However, you will be glad to learn that, from very recent reports, there is every prospect of an immediate thaw, and already 250 inches of water are reported from Last Chance Creek.

The lateness of the season, I am happy to say, is not as irreparable an evil as at first appears. Your manager, Mr. Holland, being on the ground early in February, spent his time in constructing a flume to carry waste water on to the ground to be washed, thus enabling us to commence operations this season with 1,500 inches of running water in addition to the 900 inches carried by the pipe, which Mr. Hobson considers should enable us to handle over 5,000 cubic yards per diem.

The report from Mr. Holland will prove of interest to all, but especially in two particulars:

First—As to the run last fall of 53 hours and 25 minutes, during which 5,000 cubic yards were handled, viz., over 2,000 yards per diem. When you consider that this was done with 600 inches of water and great care had to be exercised to form a lip where the bench was first opened, there can be little doubt as to the practicability of moving the large bodies of gravel by hydraulic means, on the success of which our enterprise depends.

Second—The fact of gold having been found in the sluices of last fall's washing (when as you are aware we had hardly penetrated through the under strata to the pay streak) proves that gold exists in that large body of gravel, which, not having reached with our prospecting shafts, we had calculated upon as being non-productive.

With regard to the economy of your works I have only to ask you to remember that the total amount realized from sale of stock to date is $19,000, of which there is still on hand $1,767.04, out of which will have to be paid accounts amounting to some $750, leaving in hand $1,000 to meet the pay sheet for last month. In other words the mine starts the 1st of April in perfect working order, equipped in every detail and clear of all debt.

Whether you will wait until May 1st before making any further financial arrangements, or will place say 500 or 1,000 shares of stock on the market at once, remains for you to decide.

Yours truly,
R. G. TATLOW,
President.

The election of officers then took place and resulted in the re-election of the old Board, the personnel of which is as follows: President, R. G. Tatlow; Vice-President, J. M. Buxton; Directors, George de Wolf, E. Mahon, and H. T. Ceperley.

The meeting then adjourned.

The Wright Cement Co., (Ltd.)—gives notice of application of incorporation under Dominion Statutes. Authorized Capital, $250,000, in shares of $100. Head office: Hull Que. Directors: C. B. Wright, Ruggles Wright, and C. M. Wright, Hull, Que; Hector McRae and W. J. Campbell, Ottawa. Formed to purchase the business carried on under the name of C. B. Wright & Sons, at Hull, Que., as manufacturers of brick, tiles, drainpipes, plaster of paris, hydraulic cements, etc.

Stanstead Granite Co., (Ltd.)—This company is applying for Dominion charter to acquire and work granite or other quarries in the Dominon of Canada. Capital, $100,000, in shares of $100. Head office: Stanstead Junction, Que. Directors: Hugh W. Elder, John W. Elder, and Jean B. Fregeau, of Beebe Plain, Que.

The Kookagamaming Gold Mining Co., of Ont., (Ltd.)—is the name of a new company seeking incorporation under Ontario Statutes. Capital, $200,000, in 40,000 shares of $5.00. Head office: Toronto. Directors: David Hunter, W. H. Cathro, G. L. Macdonald, Henry Lemon, A. G. Lundlack. Formed to explore for and mine minerals and ores in Ontario. Operations to be carried on in the district of Nipissing.

Rat Portage Mining Co.,—is applying for Ontario charter, to carry on the business of a mining and reduction company, in the district of Rainy River and Thunder Bay. Head office: Rat Portage, Ont. Capital, $3,000,000. Directors: E. Wilber Barnes, Albert B. Upton, and A. C. Boyce, Rat Portage Ont.

The Holmes Fibre Graphite Co.,—is applying for Ontario charter. Capital, $250,000, in shares of $100 each. Directors: Dugald Graham, Fred Fairman, and Wilson Fairman, of Montreal. Head office: Toronto. Formed to manufacture fibre graphite bearings.

The Duluth and Saint Paul Mining Co. (Ltd.) was registered under the Foreign Companies' Act, at Victoria, B.C., on 8th February. Capital, $2,000,000. Head office: Ainsworth, B.C.

Spokane and Great Northern Mining Co., (Ltd.)—was registered at Victoria B.C., under the Foreign Companies' Act, 2nd February, 1893. Capital, $5,000,000. Head office: 104 Yates Street, Victoria, BC.

Freddie Lee Mining Co.,—has been registered at Victoria, B.C., under the Foreign Companies' Act, 23 March, 1893. Capital, $500,000, Head office: Kaslo, B.C.

Bell's Asbestos Company, (Ltd.)—The general meeting of the shareholders in this company was held at the Cannon Street Hotel, London, England, on Monday, 9th March, Mr. John Bell in the chair.

THE SECRETARY (Mr. G. W. Giles) read the notice convening the meeting.

THE CHAIRMAN, in rising to propose the adoption of the report and balance-sheet, said: The year to which this report and balance-sheet refers is one of a series of three years in which it has been exceedingly difficult to make money, and the last of the three years has been the worst of them. Nearly all the trades upon which we depend for our business are in a deplorable state of depression. Everywhere we are asked to made the cheapest possible things, because everybody wishes to curtail outlay. The suffering in trade seems to have been greater on the Continent, amongst the manufacturers of asbestos goods, even than with ourselves, and those of them who took sanguine views in 1890 stocked themselves very heavily with crude asbestos, and with forward contracts for further supplies, and the result has been that during the past year we have practically done no business in crude asbestos. You will recollect that this time last year I told you we had to carry over from the previous year a considerable quantity of our contracts, and, practically, those contracts which we have carried over have constituted our trade in crude asbestos; so, whilst we have been able to maintain our position as regards manufactured goods, and even slightly to improve the profits on that part of our business beyond that of the previous year, there has been a very great falling off in the sale of crude asbestos from the mines. Whilst dealing with the matter of the asbestos mines, you will recollect a year ago I told you we had two law-suits—one, in which we were plaintiffs, to defend our boundary line against trespass, and the other, in which we were defendants, contending for a boundary line which we believe to be ours, and which is disputed by our neighbors. The first decision with regard to that boundary line was given against us. We appealed, and another decision has been given against us and for us—against us as regards the boundary line, but, strange to say, in favor of us in the reduction of the damages that we were to pay. We were condemned before to pay $7,000 and the court has reduced those damages by $4,000, making the amount of damages we were condemned to pay about £600, and the parties who gained the point with regard to the boundary line have been condemned to pay costs. I do not understand a decision of that kind; but we have appealed against that decision to the Superior Court of Canada, and I hope it will be settled during the year. In the other suit we have against a person with regard to trespass upon our boundary, no decision has yet been arrived at. On the other side of the accounts you will notice, notwithstanding a shrinkage in business, that we have an increased amount of bills payable and open accounts. Our present indebtedness at the end of the year is greater than it was at the same time last year. That is entirely accounted for by the fact that the new buildings were made ready for occupation at the end of the year, and that there were large accounts to be settled at that time, and they are now in the course of settlement. We have purchased the freehold of our premises at a cost of £25,000, which sum of money we have raised by mortgage at 4 per cent. All the expenses connected with these buildings are included in the cost of £49,956, and we write off annually 2½ per cent., which is the usual thing with regard to freehold buildings. One more point in the report is that the time has come for myself to be proposed for re-election as a director of this company. It is provided in the articles of association that I should serve the company as chairman for five years; those five years have now expired, and my re-election will be submitted to you in the usual course at the end of the meeting. I should not be out of order, I think, in alluding to what has been accomplished during those five years—I do not mean to say accomplished by myself, but accomplished by the careful consideration which the directors have always given to the subject under their care, and by the assiduity of the managing directors and staffs that serve under them. During that time we have paid off rather more than £9,000 debentures, created a reserve fund of £50,000—£15,000 of which has been out of the ordinary trade profits of the Company—and we have distributed, including the dividend we propose for consideration to-day, £84,000 in dividends. I think that out of the five years—three have been years of great commercial depression, increasing since 1891—we have a fair record to show. I shall not occupy your time longer, but will now propose the resolution, which is, "That the report of the board of directors and of the auditors, and the financial statement submitted to this meeting for the year ending December 31st, 1892, be, and the same are hereby, approved and confirmed."

MR. H. HEYWOOD seconded the motion.

The resolution was unanimously agreed to.

THE CHAIRMAN then moved:—"That this meeting sanctions and approves the payment of a dividend of 5s. per share, free of income tax, payable on March 18th, 1893."

MR. A. J. BURNETT seconded the motion, which was unanimously agreed to.

MR. H. HEYWOOD proposed, and Mr. T. B. Lightfoot seconded, that Mr. John Bell be, and is hereby, elected a member of the board.

This concluded the business of the meeting.

The Horse Fly Hydraulic Mining Co., (Ltd.) gives notice of application for charter under the Companies Act, British Columbia. The objects of the Company are to take over and acquire mining leases or claims in the Province, and to carry on the business of hydraulic or other processes of mining. Authorized capital, $200,000 in shares of $10. Head office, Vancouver, B.C. Directors: Harry Abbott, W. F. Salsbury, and John M. Browning.

The Acadia Coal and Coke Co. is applying for incorporation in the Province of New Brunswick, for the purpose of acquiring real estate, minerals and mining property, mining coal, quarrying stone, manufacturing coke, and all kinds of brick, tiling and earthen pipe, shipping and selling all of the above mentioned articles, building works and erecting buildings and all other things which may be necessary or incidental to the business of coal mining, operating or trading. Authorized Capital, $1,000,000, divided into 12,500 shares of $100 each. To consist of two classes of stock, namely:—*A* stock, being the ordinary stock of the Company, to the amount of nine hundred and fifty thousand dollars, divided into nine

thousand five hundred shares of one hundred dollars each ; *B* stock, being preference stock, having preference right of dividend over ordinary stock, at eight per centum per annum annually to the amount of three hundred thousand dollars, divided into three thousand shares of one hundred dollars each. The Directors are : John W. Lowe, Stonehaven, N.B.; George R. Sangster, Moncton, N.B.; W. T. Whitehead, Fredericton, N.B.; F. P. Thompson, Fredericton, N.B.; John W. Y. Smith, Dorchester, N.B.

Boston and Nova Scotia Coal Co.. (Ltd.)—This is the name of a new syndicate which is seeking an Act of Incorporation from the legislature of Nova Scotia. Some difficulty has been experienced in getting at the actual facts, and at present we must defer from going into detail until more information is available. The authorized capital is $1,000,000. The applicants include the Hon. W. Chandler, and J. C. Cobb, Boston ; David S. Baker, Providence, R.I.; W. J. Fraser, Halifax ; A. C. Ross, North Sydney, C.B.; R. P. Fraser, New Glasgow ; P. O. Mullin, Halifax; John McKeen, Mabou, C.B. The special object of the company is to acquire and work the Broad Cove coal areas, Inverness county, C.B., and the construction of a line of railway from Broad Cove to Orangedale and thence to Cariboo Cove at the mouth of the Straits of Canso.

The Standard Coal Company is the name of another coal company seeking incorporation by Act of the Legislature of Nova Scotia, for the purpose of operating the Shannon areas at Port Hood, C.B.

The Future of the Mining Industry in the Province of Quebec.

By J. OBALSKI, Inspector of Mines for the Province.

The Province of Quebec has an area of 188,688 square miles, which will no doubt shortly be augmented by the territory between our present northern boundry and Hudson's Bay, same comprising 116,539 square miles ; the population at present is say one million and a half.

Of this large area about 40,000 square miles only, have been settled upon, (and although of course a considerable amount has been inspected for timber) there remains an immense area comparatively unexplored. A glance at the map of the Province will indicate more clearly than words can, the relatively small proportion of surveyed and settled territory.

It may be said that the mining industry in this Province forty years ago was *nil* ; the only operations then carried on being the production of iron in the St. Maurice district on a small scale. It soon became known, however, that minerals existed; the discovery of gold was quickly followed up by that of copper, and subsequently phosphate, asbestos, mica and several other minerals or ores of minor importance. The history of these is similar to the discovery of minerals in other parts of the world, viz : the populace is excited, a boom and speculation result, high prices are obtained, followed by a depression, after which matters come down to a business footing, and a steady volume of trade at remunerative prices is established. The capital interested in this Province is principally English and American, and it is apparent that every facility should be afforded foreign capital to come into the country, and thus hasten the development of our minerals. The present product of the mines is largely shipped to Great Britain, Europe and the United States, who in many instances impose a duty on same, for example, 75c. per ton on iron and copper ore going to the United States, and 25% on manufactured asbestos goods, etc.; we are also obliged in some instances to import machinery, so that when the circumstances are fully considered we need not be surprised that our province does not advance more rapidly than is the case at present. We have made considerable progress, nevertheless, which can be seen by a comparison between the state of this industry in 1880 and that of the past year, 1892, as given below :—

1880.

The Beauce Gold fields laid idle owing to legal complications.

Copper ore at Capelton operated by two concerns, shipping ore and matte.

Phosphate in Ottawa District opened up, about 8,000 tons shipped.

Asbestos worked in Eastern Townships and a few hundred tons shipped.

Iron ore blast furnaces at Radnor and Drummondville using a few thousand tons of ore.

Building material operated on about same scale as at present.

Little or nothing done in other minerals.

1892.

Gold—The legal question disappeared and work resumed on alluvial deposits in Beauce and Compton. The quartz veins are prospected and result is encouraging.

Copper—Worked by three large concerns ; 57,641 tons extracted, and 53,413 shipped, to the United States. A factory has been erected which produces sulphuric acid and chemical manure, the latter used in connection with the Ottawa phosphates.

Phosphate—The maximum output since 1880 was 26,000 tons in 1885, but owing to depressions in prices at present the output is only 11,000 tons about.

NOTE—I consider the present depression only a temporary one, and that there is a future for our apatite on account of the sustained high grade of same, viz.:—80% and upwards, and which in reality constitutes a different class of phosphate, and is not a common article.

Asbestos—The shipments in 1890-91 exceeded 7,000 tons each year, but in 1892, owing to difficulties between producers and consumers, and a depression in prices, the quantity shipped is much less.

Iron Ore—A modern furnace was erected at Radnor and 26,540 tons of bog ore was used at this place and Drummondville. A quantity of 8,700 tons of magnetic ore was shipped to the U. S.

Lead—Important work has been done at Lake Temiscamingue, but operations are suspended at present.

Mica—Large operations are being carried on in the Ottawa District, the product being chiefly amber mica. In the Saguenay region white mica is found in abundance.

NOTE—The employment of mica in constructing dynamos and other electrical appliances, has created quite a market for this product, and as same is likely to increase rather than diminish, it would appear that there is a brilliant future in store for this industry.

Ochre—Two important concerns are now working in the vicinity of Three Rivers, and their output is steadily increasing.

Petroleum—Numerous borings have been made in the Gaspé District, and oil has been struck in small quantity. A considerable amount of money was invested in careful prospecting, and better results are anticipated in the future.

Building Material—Slate, granite and limestone are worked on a large scale, and I would draw attention to the granites and marbles of the Laurentian formation.

By comparison of the two periods, we can now see the progress which has been made, and which under certain circumstances might have been more.

I cannot speak with great exactitude regarding the amount of capital invested in mining operations in the province, but roughly speaking it would be about eight millions of dollars, and the value of plant, etc., very near one and a half million.

Prospecting is continually going on and new discoveries are made frequently. The next ten years, I confidently expect, will show a marked increase in production and development of our minerals. With our population steadily increasing a larger local trade will be the result ; Canadian capital is now being invested on a larger scale, and if certain changes in the tariff can be arranged it will tend to make the markets easier of access, enlarge same and thus raise the market price of our commodities.

It will be remarked that the copper, phosphate, asbestos and iron industries are well established, and in a fair way to ample development. Mica is making rapid strides, while Ochre, I consider, must also become important. Gold mining in Beauce, if I am not mistaken, will, before long, meet with the attention it deserves, and we may expect to see our graphite regularly worked in the near future, as well as petroleum in Gaspe and the central portion of the Province, which, in addition, contains natural gas, as yet untouched. Other minerals such as galena, rich copper ore, chromic iron, antimony, etc., are worthy of attention. We have no coal in our Province, but fuel (wood) is plentiful, and will be so for some time time to come ; after a certain time, however, I have no doubt that our practically inexhaustible beds of peat will come into use.

As a matter of fact our mining industries give direct employment to over 3,000 hands, not including that required for transportation, etc.

I would now remark that to-day, we see in this Province mining industries established on a sound basis, constantly increasing and improving, while at the same time we must admit that the majority are, so to speak, only in their infancy, but bid fair to rival those above mentioned. Altogether the outlook is encouraging in a great measure. It is my opinion that as our population increases and civilization advances, new discoveries will be made, capital invested and the mining industries of the Province eventually become the leading business of the country instead of timber, as at present. Favorable customs arrangements with other countries would give a great impetus, I consider, to the mining business of our Province.

The present mining law gives satisfaction, and with the co-operation of the mining community, will materially assist in the development of the resources of our Province.

I look upon the General Mining Association of the Province of Quebec as an important body, and consider that its efforts, if well directed, cannot fail to be of great advantage in many ways to the country.

Subjoined I give some statistics relating to this Province's production for the year ending 31st December, 1892 ; it was impossible to get complete returns in time for this meeting, however.

STATEMENT OF PRODUCTION OF MINERALS, ETC., IN THE PROVINCE OF QUEBEC, FOR THE YEAR ENDING, 31ST DECEMBER, 1892.

Description.	*Hands Employed.*	*Output.*	*Shipments.*	
Copper Ore	538	57,641 tons	53,415	tons
§Gold	70	350 oz.		
Iron Ore	1,149†	28,090 tons	8,750	"
Asbestos	Returns incomplete.		‖5,491¾	"
Phosphate	do		*‡9,060	"
Mica	do			
Plumbago	....	.....	4,590	cwt.
Galena	....	.....	15	tons
Soapstone	....	.....	40	"
Granite	....	.....	Over 100,000 c.ft.	
Slate	Returns incomplete			
Ochre	do		About 1,100 tons	

*It is reported that about 2,000 were shipped from from other points.

§Some small workings have not been reported.

[†It ought to be explained that the whole of the above force cannot be properly charged to the production of iron, nor is it employed all the year round. The Canada Iron Furnace Company for instance is the principal producer and a large proportion of its labor is engaged in cutting and hauling lumber, in making brick and other work incidental to the various operations of the company. —Editor CANADIAN MINING REVIEW.]

‖From Eastern Townships.

‡From Montreal, proncipally from this province.

QUARTERLY GENERAL MEETING

OF THE

General Mining Association

Of the Province of Quebec.

The Spring Quarterly General Meeting of the General Mining Association of the Province of Quebec, was held in the new Club Room, Windsor Hotel, Montreal, on Friday, 7th April. There were present: Capt. R. C. Adams, (Anglo-Canadian Phosphate Co.), Montreal; L. A. Klein, (American Asbestos Co.), Black Lake ; J. Burley-Smith, (British Phosphate Co.), Glen Almond ; S. P. Franchot, (Emerald Mining Co.), Buckingham; R. T. Hopper, (Anglo-Canadian Asbestos Co.), Montreal; Prof. B. J. Harrington, (McGill University), Montreal; F. Cirkel, (Templeton Asbestos Co.), Templeton; W. H. Jeffrey, (Danville Asbestos Mines), Montreal; Thos. W. Gibson, (Bureau of Mines), Toronto ; Theo. Doucet, N.P., Montreal ; F. A. Halsey (Canadian Rand Drill Co.), Sherbrooke; John M. Jenckes, (Jenckes Machine Co.), Sherbrooke ; George R. Smith, (Bell's Asbestos Co.), Thetford Mines; John J. Penhale, (United Asbestos Co.), Montreal; — Dickson, Montreal; A. W. Stevenson, C.A., Montreal; F. D. Taylor, Montreal; E. W. Gilman, (Ingersoll Rock Drill Co.), Montreal; Daniel Smith, (Hamilton Powder Co.), Brownsburg; and B. T. A. Bell, Secretary. At the afternoon session a number of students attending the mining classes at McGill University were present. The morning session opened at 10 a.m. The Hon. George Irvine, Q.C., President of the Association, owing to an unfortunate fatal illness in his family, was unable to be present, and Capt. R. C. Adams, was called to the chair.

The Duty on Mining Machinery.

CAPT. ADAMS—Perhaps the secretary will present the report of the deputation appointed at last meeting to interview the Government respecting the duty on mining machinery?

MR. B. T. A. BELL—The deputation appointed by the Association had an interview with the Hon. Mr. Clarke Wallace, Controller of Customs at Ottawa, on Wednesday, 9th March. We were given a courteous hearing and the Controller was apparently interested in our objections to the operation of the present law brought under his notice. I undertook, on behalf of the Association, to prepare a statement for reference in the Department, showing the classes and kinds of mining machinery made in Canada, as well as a list of those specialties which we knew were not manufactured and which have to be imported. With a view to giving our home manufacturers an opportunity of fair representation, I addressed a circular letter to each, asking for returns of their manufactures and I also invited them to be present at the discussion this morning. A full stenographic report of the interview was taken and perhaps it might be interesting to have it read. Since the question has been brought up at this meeting I do not think there is any necessity of going into any resolution asking for free importation of machinery, because the Dominion Government will not entertain such an idea. The question comes up, is the imported plant simply forming purposes? Blast furnaces and gold mills and metallurgical works are manufacturing interests all co-related with mining, but according to the definition of the Act, are excluded from free imports of machinery. For instance here is a point in question that has been brought to my notice by Mr. McDougal, of St. Hyacinthe, who is projecting a new plant for the manufacture of peat fuel.

(Letter read).

MR. S. P. FRANCHOT read the stenographer's report of the interview, and also the list of mining machinery fyled in the Department of Customs by the Jenckes Machine Company, Sherbrooke, and which, officially endorsed by the late Commissioner of Customs, Mr. Johnson, was used by the Government as a reference at ports of entry.

MR. L. A. KLEIN stated that he had at a recent period wanted a Block-hole drill and that he wrote to the Canadian Rand Drill Company for it. The company replied that very few of those drills were made, that they would have to get it for him from their house in New York, and that he would not be able to get it at such a satisfactory price as otherwise, as they would have to pay duty on it. Mr. Klein stated that he favored requesting the Government to allow mining machinery to come into Canada free of duty.

CAPT. R. C. ADAMS moved that: "Whereas the Dominion Government have stated that they are contemplating a revision of the tariff and that, looking to this end they have invited information upon the subject; and whereas the best interests of the Canadian Mining would be conserved by the removal of all duties upon mining machinery: Therefore be it resolved that the Dominion Government be respectfully requested to consider the practicability of granting this benefit."

MR. S. P. FRANCHOT seconded the motion, which was carried.

MR. HALSEY said: I may say in relation to Mr. Klein's remarks that the special drill he asked for is a little drill which we had never before been called upon to furnish. His application has been the only one of the kind in our experience; and I may say in point of fact made the only case which would have necessitated our importing machinery. One thing more. In the report of the interview with the Customs Department just read, the name of the Daw drill was mentioned as one of those wonderful machines. I have had full drawings and specifications of that drill made and I want to say distinctly that no man in Canada or any where else who has had a Rand or an Ingersoll in his mine would have a Daw; and that applies to many other kinds of imported machinery.

MR. B. T. A. BELL moved: That a special committee, representing the mineral operators of the province, consisting of Mr. L. A. Klein, Mr. John Blue, Mr. J. Burley Smith, Mr. George R. Smith, Mr. S. P. Franchot and himself with an equal number of gentlemen representing the manufacturing interests of mining machinery in Canada be appointed to frame a statement of mining machinery not manufactured in Canada, and that the said statement be submitted to the various mining associations for approval before being finally submitted to the Department for official reference.

MR. JOHN PENHALE seconded the motion, which was carried.

The meeting then considered and adopted several important amendments to the Constitution and By-Laws and adjourned at one o'clock.

Afternoon Session.

The members re-assembled at half-past two o'clock, the club room being filled. Capt. R. C. Adams, Vice-President, who occupied the chair called for the first paper on the programme, entitled:

Mica Deposits in the County of Ottawa.

MR. F. CIRKEL (Templeton)—The mineral mica has assumed last year such considerable and economic importance that the attention of mining men and capitalists is directed at present very much to the mining of this mineral. Although the presence of the brown or so-called amber mica in the province of Quebec has been known for very many years, but little value was attached to it, the uses for the mineral and the market being exceedingly limited. Phosphate mines, worked formerly on a large scale, have yielded sometimes considerable quantities of mica, but the latter was thrown into the dump on account of its being considered as worthless. This brown or amber mica, a magnesia mica of the phlogopite species, occurs in scaly particles as an essential constituent of many eruptive and metamorphic rocks, such as gneiss, granite, porphyry, etc., and in this mode of occurrence it is only of geological or lithological importance; but as an economic mineral, as a mineral of commercial value, as which it may come here in consideration, we have to refer to the deposits of mica, more nearly related to the limestone and pyroxene groups of the Laurentian system.

The principal areas where those phlogopite mica deposits are to be found in the province of Quebec, are confined to the Ottawa County and more especially to the districts of Wakefield, Templeton, and the Lievres. It occurs chiefly in the pyroxene rock which traverses in great masses the crystalline limestone, and forms crystals, aggregates of crystals, pockets or veins in great irregularity. Single crystals of every size, from a few inches up to two and three feet in diameter, are found imbedded and distributed irregularly over the whole rock; they are for the most part complete in their structure, afford occasionally limestones of two feet square, the sheets being free from wrinkles and crevices, and therefore of great economic value. Very often we see them associated together in aggregates, in pockets or deposits of highly irregular form and shape. In this form they are pocketed close together, cemented occasionally by crystalline limestone, penetrating and replacing each other and appear therefore in a much contorted and twisted state. These pockets or aggregates are mostly in connection with each other by chains of small sized crystals and in the adjacent rock we find very often a large amount of crystals distributed. In following these chains many valuable discoveries of large mica masses have been made in consideradle depth. The third kind of occurrence, and which is the most important from a mining point of view, is the vein-like occurrence. We hardly can say that the mica occurs in veins itself as it is for the most part an intimate connection of pockets and larger masses of mica crystals. These deposits resemble each other in many respects. Their general outline is approximately lenticular, as can be seen from surface indications and vertical sections in considerable depth. Veins of this class are found traversing all the strata, they are most frequently vertical in attitude and cut the bed in nearly every direction. They exhibit within certain limits great variations in their geological character not only in different deposits, but in different parts of the same deposits. While some consist of nearly pure mica crystals, others will be found to be characterized by an admixture of grains or small pockets of apatite, pyroxene, feldspar or carbonate of lime either alone or variously associated and sometimes in such quantities as to make up large portions of mica deposits. We observe occasionally a certain regularity in the vein-like deposits as far as the dip, the width and the horizontal extensions, but this feature is to be considered as seldom. On lot 15 in the 11th range of Templeton, there were on the surface two vein-like deposits, with small contorted crystals in a distance of about 10 feet, the walls being parallel, in width from two to four feet; the same were tested by a shaft and in a depth of 15 feet those two bodies came together, forming a single vein of eight feet wide and crossing the whole size of the shaft; this vein continued most regularly in the shaft and in about 25 feet a large phosphate body was struck, the veins split up and the crystals being distributed over the whole body; the same were large sized and most regular in their structure, yielding a great amount of flat sheats. Mica crystals frequently line drusy cavities in fissures; they preserve in this mode their sharpness of outline, and are for the most part not contorted. Their regularity and frequently large dimensions serve to distinguish them from the crystals of the other mode of occurrence.

Taking all observations together, we must say that we have a great variation in the occurrence of mica deposits; we find in one and the same belt very frequently all different modes, as single imbedded crystals, as aggregates and as pockets and veins and it is difficult to say which mode of occurrence is a characteristic feature for oue or the other pyroxene belt. We see for instance in Lot 15, Range 8, Templeton, all kinds of deposits represented; we find in an open cut in a mountain ridge well defined single crystals, aggregates of crystals, veinlike deposits, some of them being of elliptical section. For the most part however we can say that the mica deposits occur as lenticular masses, frequently interrupted by the country rock.

On account of the great irregularity and the variation of occurrence, surface indications are not sufficient to give a judgment about the value of mica deposits, as many of them prove of superficial character; they have to be opened up and in considerable extent developed, especially in depth in order to gain a knowledge of their nature. In many cases we find that the soil contains a considerable amount of mica crystals, but there is no leading featute to determine with certainty that also the underlying rock likely contains mica deposits. This has observed in several places especially on mountain slopes and is due to the weathering process in nature and action of water-streams, which in course of time excavate the superficial deposits and place laminaes of crystals in lower levels. Further we notice that the mica appears in a much contorted and twisted state in a most shattered rock, sometimes in very large extent. Such deposits cannot be considered as worthless, as we know that all rocks are constantly undergoing decomposition and decay; in these cases sufficient development to the depth must be made in order to gain a knowledge of the conditions in the sound rock and we observe that deposits with contorted mineral on the surface have proofed in many cases very valuable in lower levels.

As for the conditions of the deposits in the depth we have to refer here to the investigations made by different mines in the Templeton and Wakefield deposits. In these mines valuable deposits have been found in a depth of 150 till 250 feet, of the same nature as described above and these investigations have shown that in nearly all cases there is a leading connection between the lenticular and veinlike deposits. And with regard to the genesis of those deposits we can state that the nature of the latter in the depth must be the same as observed in higher levels.

Concerning the quality of the amber mica it has been stated by experts that it is well adapted for all purposes, which mica of foreign countries has been used for hitherto; it has a yellowish color with pearly metallic lustre. Chemical analyses have shown that the darker mica contains more iron than the lighter colors, and it may be that this has an influence upon the uses of the darker species for electrical purposes. The regular, well defined, six sized crystals are for the most part obtained from cavities, while the crystals from aggregates or large sized pockets do not prove as valuable for commercial purposes, in being much contorted. The laminaes of the large sized crystals hold sometimes between them plates of calcite or quartz, or flakes of plumbago. In one case a well defined crystal of apatite was found imbedded in a mica crystal, which had evidently crystallized around it.

On account of the irregular distribution of the deposits and the shattered and contorted condition of the mica itself it is evident that the bulk of rock and waste mica, necessary in order to obtain one ton of merchantable mica is great and with regard to the varied methods adopted in the different mines it is difficult io get reliable details, so as to make out the exact average cost of production of the merchantable mica. As for the percentage of cut mica in the run of mine, the figures obtained differ greatly; in one mine there were cut out 5,500 lbs. mica.

50 lbs., 4 x 6 inches and higher
125 lbs., 3 x 5 " "
1,500 lbs., 2 x 3 " "

or altogether about 30 per cent.

The Industrial Uses of Mica.

MR. B T. A. BELL—During the past three months, as most of you know, I have had my hands more than full, and I would therefore crave indulgence if the bald and unpretentious notes which I now submit fall far short of the requirements of a paper dealing with a subject of so much interest and importance. I have simply noted roughcast from such sources as were at hand, a few features of the mica industry which I have thought might be useful in supplementing the papers presented today by the other members. In doing so it may not be out of place, considering the importance of our market in the United States to glance briefly at the outset at the mica mining industry of that country.

Occurrence in United States—The localities at which mica occurs in an available form are not numerous and its production has been confined to the States of North Carolina, New Hampshire, Virginia and South Dakota. It is also known to occur in Wyoming and Washington but no development has taken place.

Mica Mining in North Carolina—In North Carolina the mineral has been mined since 1868. In the fall of 1867 "says Mr. W. B. Phillips," (Mineral Statistics, U.S.A., 1885). "General Clingman was told by a New York dealer in mica that a good quality was then so scarce that he had been obliged to pay as much as $8.00 per pound for some small sheets. This induced the General to institute a search for good mica in North Carolina. He began work in the latter part of 1867, or early in 1868, and from Cleveland county obtained several barrels of good mica which he sent to New York. A little work was done in Rutherford and Burke counties, but with no satisfactory results. Having an intimate knowledge of Mitchell and Vancey counties, he decided to prospect there. In his own words "I selected as the best points for work the Ray mine, Yancey county, the Silver mine, and Buchanan mines in Mitchell county. It was my singular good fortune to choose the very best of the three mines that have since been found most valuable." General Clingman then returned to New York and made an agreement with Messrs. Sloan & Mendon, of Liberty Street, to engage in the mica business together, and Mr. Mendon came out to North Carolina and visited the Ray mine. Not being much impressed with the outlook however, he returned home, and shortly afterwards, together with Mr. Sloan abandoned the enterprise. General Clingman carried on the work alone at the Silver mine, and got out several hundred pounds of mica. Being obliged to leave in order to attend to some more pressing business, he instructed his foreman to collect all the mica and store it away. This however was not done, and several large blocks were left on the ground. A stock drover passing that way with his wagon picked up one of these and carried it to Knoxville, Tenn. There it was seen by Mr. J. G. Heap, of the firm of Heap & Clapp, dealers in stoves and tinware, who at once recognized its value. Disposing of their business they went at once to Mitchell county and began mica mining. This was in 1869. For several years they conducted a very profitable business, realizing for some of the mica, as much as $11 per lb.

For some years the business was carried on quietly.

Mica Production in United States—Prof. W. C. Kerr, (Min. Res. U.S.A., 1882,) estimated that the production to the end of 1881 was 400,000 pounds valued at $800,000. In 1887 it was estimated that the total value of the production in North Carolina from 1868 to 1887 amounted to 762,400 lbs. of a total value $1,608,500. Since then the production has steadily declined. In 1884, it was estimated at $253,000; in 1889 it had dropped to 6,700 lbs. of a value of $7,000. The average depth of them ines is quoted by Prof. W. C. Kerr, at 75 feet, only two, the Clarissa, 3½ miles east of Bakersville, Mitchell county, and the Flat Rock in the same neighborhood having attained a depth of between 300 or 400 feet. Nearly all are worked by shafts, vertical or underlie. Steam power until very recently being used very sparingly, most of the hoisting being done by horse-power.

A better idea of the retrogressive nature of the mica industry in the United States may be gathered by a comparison of the United States Census Statistics. In 1880 there were in that country 78 mica mines, 71 of these being in North Carolina; of these 78, 22 were worked, 17 of them in North Carolina. The invested capital was $337,900, $6,900 being in North Carolina; total number of hands employed 272, in North Carolina 177; total paid in wages $65,000; total production 81,669 lbs., valued at $127,825; North Carolina producing 42,669 pounds valued at $61,675.

In 1889 only a small number of mines were operated, and few of these were worked steadily. Of a total product of 49,500 pounds of cut mica, valued at $50,000, and 196 short tons of scrap, valued at $2,450, one mine

in New Hampshire produced 40,000 lbs., valued at $40,000, and 160 tons of scrap valued at $2,000- Of the North Carolina mines none were in steady operation, and the production of that State, aggregating 6,700 pounds, of a value of $7,000, was the result of irregular and spasmodic efforts. The balance of the product viz:—2,800 pounds of cut mica valued at $3,000, and 36 tons of scrap came from one mine in Virginia which was exhausted early in the year. In the Black Hills region, South Dakota, where, in 1884, eleven mines were in operation with a production of over 18,000 pounds of mica, only one produced in 1889 and that only a small amount. The whole industry employed but 174 persons, and $58,335 was expended in wages, supplies and other outlays.

In 1882, cut mica was worth $3.50 per lb.; in 1883, $2.50; in 1884, $2.53; in 1885-6-7, $1.75; in 1889, a fraction over a dollar; in 1890 there were signs of improvement and the total product in the United States, aggregating 60,000 lbs., was valued at $75,000; in 1891 it had increased to 75.000 lbs., of a value of $100,000.

Imports of Mica into the United States—In October, 1890, the McKinley Tariff placed mica on its dutiable list at 35 per cent. *ad valorem*. Notwithstanding this protection the imports into the United States in that year were more than double that of any previous year, having increased from $1,165 in 1869, to $9,274 in 1879, and $97,351 in 1889 to $207,375 in 1890. A comparision of the sources from which the United States draws its supplies may be gathered from the following returns for the year ended 30th June, 1890:—Germany, $3,500; England, $64,611; Canada, $25,105; British East Indies, $49,058; Sweden and Norway, $4,695.

Mica Production of Canada—On the other hand the value of the production in Canada has steadily advanced as may be gathered from the following figures quoted from the returns of the Geological Survey of Canada: 1886, $29,008; 1887, $29,816; 1888, $30,207; 1889, $28,718; 1890, 68,074; 1891, $71,510. For the twelve months ended 31st December last year (1892) the value of the exports from Canada had increased to over $100,000, of which the Ottawa district contributed no less than $54,729.82 to the United States.

This leads me to note briefly some of the uses to which the product is applied.

Stove Panels—In 1876 when I first became associated with the industry through my connection with Mr. E. Grant Powell, of Ottawa, at that time agent for the sale of the product of the British and Canadian Mica and Mining Company's mine in the township of Villeneuve, Ottawa County, Que., manufacturers of stoves in Canada and the United States consumed 95 per cent. of the output. The Villeneuve mine in Ottawa county, and the properties worked by Smith & Lacey at Sydenham, Ont., were the principal producers, though several surface deposits were opened by farmers, who worked them occasionally when business was dull, and realized fair profits on their production. It was then almost wholly utilized for the pannelling of stove and furnace doors. For this purpose it had to be clear, free from spots and of a uniform color throughout the sheet.

Electrical Insulation—The great factor in increasing the consumption of mica has been its demand for electrical purposes. "The insulating power of mica," says an eminent electrician, "is superior to that of any other substance applicable to armatures. An advantage, peculiar to itself, is its even laminated structure. How wonderful is the thinness of its individual layers! A piece of ordinary writing paper is about .005 inch; mica layers have been obtained of a thinness of .00003 inch. Mechanical difficulties prevent its being split thniner. By pasting it upon a hard surface and splitting it off as much as possible, the remaining fragments are so thin as to become beautifully iridescent. The builders of armatures can therefore split the sheets into any desired and uniform thickness with great ease and accuracy. An interesting property of mica and one not generally recognized, is its homogenity of structure and clear transparency, although so black when thick. A valuable property of mica in connection with commutator insulation is its proper degree of hardness, whereby it does not wear away too rapidly under the action of the brushes. If rubber was used for example, even if it did not burn, yet it would wear off and sparking result, because the commutator surface would not be truly cylinderical. The brushes would be set into vibration.

"Again, mica is capable of the finest pulverization, so that any wearing which does take place does not result in the liberation of gritty particles, which would cause sparking. Such mishaps occur with hardened artificial plastic insulators. The insulation should be just so thick that the cnrrent cannot jump across from one section to the other."

"Of all substances," says the same authority, "mica is probably the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuit or bad construction, will have no injurious effect on mica. Mica, thick or thin, may be held in a glass flame without burning or melting. It remains unaffected."

The introduction of mica into practice appears to have been brought about in the following manner:—An accident would happen to an armature, and before the next night it must needs be repaired. In order to make the temporary remedy, mica sheets or bars would be interposed. In case of subsequent accidents the portion repaired by mica was the last to yield. Therefore it was proposed to build the armature primarily with mica.

The Canadian mica, on account of its superior cleavage, is preferred by electricians in the United States to the home product and after gaining a foothold in the American markets it has more than held its own against the local and foreign product. An instance of this may be cited in the following communication to the Geological Survey of Canada from the Edison General Electric Company of New York (See Annual Report Mineral Statistics, 1890, pp. 104 and 105 s.), which says: "The bulk of mica used by us is Canadian mica, which is known in the market as 'amber mica,' being of amber color and clear. It is essential that the mica should be smooth, free from wrinkles and crevices, it must split readily and must be flexible, so much so that a piece of mica .010 in. thick would bend to a curvature of about 3 in. diameter without cracking. Mica that has dark spots or spots similar to rainbow colors, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration. We give you below the principal sizes of mica used by us, and would say that at the present time we have orders out for some of the sizes ranging from 200 to 600 pounds:—Commutator mica: 1½ x 4 in., 1¼ x 6⅝, 1⅝ x 4¼, 1⅜ x 6½, 1⅜ x 8, 1¾ x 8, 2 x 5, 2½ x 5, 2 x 7, 2 x 12, 2½ x 12, 4 x 4, 5 x 8. Binding mica, 1¼ in. wide."

Micanite—In a paper read this year before the American Institute of Electrical Engineers, a Mr. Thompson describes the use for insulation of pulverized or comminuted mica mixed with a liquid cement and rolled or compressed in various forms known as Micanite. Mr. Thompson says: "Although so superior for armature insulation, mica is, in its natural structure accompanied by certain objections, which, in trying to overcome, were more serious than had been anticipated, as it was not until after a long series of trials that a successful article was produced, and not until a novel apparatus for cheapening the process of manufacture was devised. The apparatus is now in operation on a large scale.

He claimed first:—Mica, as found in nature, occurs in flat sheets only. It has a high degree of elasticity, so that when once bent and released, it assumes its original form. If folded, its brittleness causes fracture. If the natural sheets are compressed in a mold, to try to form armature insulator heads for instance, it is completely broken up.

Secondly. Natural mica sheets correspond financially to plate glass. The larger the sheet, the higher the cost per square inch. Mica in small pieces, from four to six square inches, is exceedingly abundant and very cheap. It is often called waste mica, because very limited in its uses, and consisting often of trimmings from larger and more useful sheets. In medium and large sizes of armatures, the naturally built up mica is so expensive as to be objectionable, although not so much so as to entirely prevent its employment.

Thirdly. Between the hundreds, nay, thousands, of thin layers, damp air can enter, and also water, accidentally, which cannot easily or effectually be removed.

Fourthly. Mica splits so easily that handling causes injury.

Fifthly. Mica cannot be cut transversely to advantage. The edges are unworkmanlike, being ragged and jagged. Neatness in drilling, sawing and turning is difficult.

Among the attempts which have been made to overcome these objections are those involving the use of pulverized or comminuted mica, which is mixed with a liquid cement and stirred into a paste. While still soft, the mixture is rolled or compressed into any desired form, as if consisting of so much plaster-of-paris. In order to give it sufficient strength, one-third of the product is cement. The mica sparkles here and there on the surface, as it glitters on granite. This article should be called a cement insulator, and not a mica insulator, because the current can flow in a straight circuit through the plate without encountering any mica. The cement forms numerous rectilinear paths for the currrent, independently of the mica; and therefore the product is in no sense an equivalent of mica.

A modification of this tpye of insulator consists of a coarse and thick textile fabric, whose pores and meshes are filled with a mixture composed of comminuted mica and a suitable adhesive substance. Another consists of finely divided asbestos mixed with pulverized mica, silicate of soda, and sulphur compounds. It is molded by pressure into any desired form.

The comminuted mica-cement type is useful in trolley wire supports and similar insulators, but for dynamos it is useless not only for the reason stated, but because of its softening and running under slight heat, being so necessarily rich in cement. If the cement is that kind that chars, the mica crumbles apart. Mineral powders have been mixed with it, to render it more fire-proof.

An example of the manner of using non-comminuted mica between the core and the windings consists in covering the core with paper, laying sheets of mica over the paper, then laying on another sheet of paper, fastening the whole together by convolutions of cord or similar ligatures, and finally applying the coils. During operation, the paper and mica may shift from their positions, and thereby affect the rigidity of the armature as a whole. Again, the process of applying the pieces, and keeping them temporarily in position, requires repeated efforts and results in a display of crude workmanship."

Mica for Glasses and Spectacles—The best employment of the immense quantities of scraps and fragments of waste mica which suggests itself as worthy of a wider field than it now possesses is the substitution of mica for glass in spectacles worn by workmen, especially stone and metal workers, to protect their eyes from chips and splinters. As already made in Germany, these mica glasses are concaved in the shape of watch glasses, and are about one twenty-fifth of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles cannot be broken. Pounding with a sledge hammer merely flattens them, nor does molten metal poured on the mica affect it. The shower of pointed iron particles which issues from lathes merely rebounds from the elastic mica glasses.

Paints, Wall Papers and Ornamental Uses—Another use for mica is its application, when previously colored or metalized, to ornamental purposes. From its unalterable nature the material preserves gilding, silvering or coloring from deterioration; and from its diaphanity, the articles so treated will preserve all their brilliancy. Finely ground mica, or colored gelatin, also shows handsome effects, and when mixed with a solution of gumarabic, it makes a good silver ink. The gelatin combination is used for inlaying buttons. Another beautiful application of mica is in the production of bronze-like colors, which bear the names brocades, crystal colors and mica bronzes. Among the advantages of these are that they are indifferent to sulphurous exhalations, are very light in weight, and in some colors are even more brilliant than the metal bronzes. When small particles of mica silver are spread over articles coated with asphalt varnish, the result is a good imitation of granite. The crystal colors are also suitable for calico printing; and fabrics to which they are applied surpass in brilliancy the heavy bronze and glass dust fancy fabrics of Lyons. Such colors have been used to decorate procelain and glassware, the articles undergoing a second heating up to the fusing point of their glazing. By suitable dyes, the material is colored to a variety of hues.

As a Lubricant—The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes its value lies in the fact that it is absolutely anti-friction, and it is claimed with its use hot boxes or journals are simply impossible. A visit to the works of the Railroad Mica Lubricating Company at Denver, Colorado, is thus described.

The mica comes to the factory in carloads, just as it is taken from the mine. It is fed by boys into two machines, which cut it into fragments about half an inch in size. By a system of pneumatic tubes, the mica, so cut, is delivered to the atomizing machines, which grind it into powder.

These machines one must see to fully realize their peculiar action and construction. Each machine consists of two steel shafts three feet long, with a series of gun metal spirally arranged beaters, which revolve in a closed case forming a figure. When in operation these machines make from 5,000 to 7,000 revolutions in a minute. The beaters on the revolving shafts are so arranged that the fingers on one pass between the fingers on the other shaft, so that when the material is passed through the pneumatic tubes from the feeding machine to the atomizers at a velocity of 15,000 feet a minute, the work of atomizing is instantaneous.

The mica, now reduced to atoms, continues its course at the same velocity through another set of pneumatic tubes to the sifting bins. Here the current is so retarded by the peculiar mechanism that it causes the material to settle in the various compartments, of which there are six, at the same time grading the material according to its fineness. The powdered mica is now settled in the hoppers or bins, immediately over the mixing pans. Here the several grades are drawn into the pans, which are provided with mechanical mixers, and the lubricant is made up by the use of the proper percentage of oils, mica and such other ingredients as the company uses in the manufacture of the product.

Directly over the hoppers are located the oil-tanks, which supply the mixers by a pipe running down on the outside of the hopper, on the end of which is a faucet.

At the south end of the bins there is located a large cylindrical machine four feet in diameter and ten feet high, that is called a dust arrester. Any of the material that is so light and fine that it will not settle is driven into this machine by air-currents, which thoroughly separate the mica dust from the air, where it settles in the bottom of the machine and is drawn off as needed.

It is stated that the capacity of machinery heretofore made for pulverizing mica bas been from 300 to 400 pounds a day, and then the material has not been sufficiently fine for lubricating purposes. It is claimed for this new concern that it can pulverize about five tons a day, or in ten hours running."

Other Uses—Mica has been used on board war vessels, in localities where glass would be broken by the concussion due to the firing of heavy guns. It is made into reflectors, sea compasses, inlaying for wood instead of enamel. It is also employed for roofing purposes, and in several patented processes forms a water and fireproof covering for strata of rubber, tar, canvas, felt, and similar materials.

THE CHAIRMAN—We are much indebted to Mr. Bell for this valuable collection of information on the subject. Mica has excited a great deal of interest among us in coming in when the phosphate industry was declining; and as it has come in in connection with the phosphate we have been tempted to throw it away. I remember selling 200 tons of it for 75 cents a ton, while now the better kinds bring from $300 to $400 a ton. We have heard from Mr. Bell several of its uses, and no douht several more uses to which it can be put will be discovered. I met a gentleman who told me that a certain distinguished professor had said that mica was sure to become an important factor in the industries of the future; and this remarkable discovery as an insulator for electrical purposes certainly opens a wide field in that direction.

There is a general feeling among miners of Ontario who have had to do with phosphate that mica does not as they say "go down." I think it would be well to hear from some of the practical miners here upon that point. Perhaps Dr, Ells can give us an opinion even better than the practical men. It is the coming industry in some of our sections of the country, and we would like to know what we can hope for.

MR. HIGGINSON—With regard to the depth of mica, we have found within the last three weeks mica at a depth of 225 feet from the surface in our phosphate beds, and several of the crystals at that depth were 18 inches by 2 feet in diameter.

DR. ELLS—So far as I know, the occurrences of phosphate are very closely identified with pyroxene dykes, and these dykes are deep, so that there is no reason why mica should not occur at great depths. In the case of the Villeneuve mine, the conditions are precisely the same as those of the phosphate in the pyroxene dykes. Mr. Franchot mines within 10 feet of the gneissic deposit alongside.

MR. HOPPER—The Sydenham mica people, I understand, get their best mica at a depth of 200 feet.

MR. FRANCHOT—Capt. Watters gets his best mica at a depth of 250 feet.

Messrs. J. Burley Smith, S. P. Franchot and Theo. Doucet also discussed the paper. Prof. Harrington, of McGill University, contributed an interesting address on some of the scientific aspects of the mineral, but as the revised notes of what he said have not been returned up to the hour of going to press, they are withheld until our next issue.

The following paper, by Mr. J. Bawden, of Kingston, was read by the Secretary :—

The Iron Ores of Frontenac and Leeds, Ontario.

The counties of Frontenac and Leeds form the southerly half of an extensive iron ore district, the northerly half of which is made up of the counties of Lanark and Renfrew. The latter portion is not of less interest, indeed there is reason to believe it the richer field of the two, but the greater accessibility of the frontier field by means of the Rideau Canal and the Kingston & Pembroke Railway, and the greater attention given to its features, induce the writer to confine these notes to a summary of what has been learned in the course of mining operations in the district under consideration.

In a series of Canadian Geological Survey reports covering the period from 1870 to 1875, the late Henry G. Vennor gave the results of his labors in Frontenac, Lanark and Renfrew. Prefacing his conclusions with the remark that in the then "imperfect state of knowledge respecting the Laurentian rocks proper and those which immediately follow, or interpose between them and the lower Silurian formation, any positive assertions as to the relative age of a large portion of those examined by him would be hazardous," he groups them under six divisions. (See report for 1874-5, p. 122 etc.) He states his doubt, however, as to their stratigraphical order and whether they represent one or more formations.

Approaching the highest member of Vennor's series the outcrops of the Potsdam formation occur, referred to in Logan's report for 1863 as extending from the straits of Belle Isle to the west side of Knowlton Lake, Loughborough township, a distance of 1,000 miles. This formation appears more extensively in Leeds than in Frontenac. Along its outcrops on the shores of Charleston Lake, and other lake expansions of the Rideau Canal, and on Islands in these waters, red hematite ore is met, but in what quantity no thorough exploration permits the statement. The same ferruginous outcrop extends across Frontenac from Dog Lake in Storrington to the middle of the rear line of Portland, attended at several points with deposits of the same ore. The existence of red and brown hematite in Kennebec, the topography of the south-western part of Hinchinbrooke and local reports, support the presumption that the frontier of the Potsdam sandstone extends throughout Leeds and Frontenac, a distance of 80 miles. In Lansdowne, Storrington and Loughborough, it is crossed by calcite dykes or veins carrying galena and baryta. On its northern boundary, the formation throughout a great part of its course appears in the vicinity of an extensive hypersthene gabbro, with veins and lenses of apatite, pyroxene and black mica.

The red hematites of the Potsdam formation, appear superficially to be altered pyritous deposits. A sample from lot 19, 9th Con. south Crosby, gave 28.14 iron; from lot 2, 7th Con. Bedford, 32.30 iron ; Ph. 1.02; from lot 7, 10th Con. Portland, 68.58 iron. I am indebted to the Bethlehem Iron Co., who purchased 30,000 tons of ore from the Wallbridge mine, Hastings, in 1882, for several analyses the mean of which is as follows :

Fe	48.278
Si	21.73
MngO	.251
Mg	1.833
Al	1.175
Cao	6.67
P	.036
FeS	1.62

The extremes are, Fe, 36.62; Si, 41.47; Fe, 56.9; Si, 9. The minor constituents are almost invariable. This ore is found with a boundary of dolomite on either side, similar to the position of the ore on lot 2, 7th Con. Bedford. The occurences of hematite north of the Potsdam formation, so far discovered are few. One of specular ore on lot 1, 9th Con. Palmerston, lies at an elevation above the Robertsville magnetic ore mine on lot 2, adjoining. The hematite occurences are enumerated hereunder :

Escott—Lot 7, 2nd Con.; lot 17, 6th Con.

Lansdowne—Lot 13, 10th Con.; lots 17, 18, 8th Con., lot 20, 7th Con., rear of Lansdowne, lot 11, 12th Con.

Bastard—Lot 23, 10th Con.

S. Crosby—Lot 19, 9th Con.

Limonite—Lot 1, 11th Con., rear of Lansdowne, lot 21, 7th Con., Bastard.

Loughboro'—Lot 7, 9th Con.; lot 25, 13th and 12th Concessions.

Portland—Lot 7, 10th Con.; lot 6, 14th Con.

Bedford—Lot 15, 3rd Con.

Palmerston—E ½ lot 1, 9th Con.

Kennebec—Lot 11, 8th Con.

The first furnace and forge built in Ontario at the beginning of this century, were supplied with ore from lot 11, 12th Con., rear of Lansdowne. Tradition does not speak well of the character of the material made. Nevertheless the wide distribution of a ferriferous formation like the Potsdam and the little disturbance it has undergone in these counties, should encourage the search for hematite ores under the drift and alluvium wherever the least indication warrants it. If the ore grades low the time is perhaps at hand when it will be found economical to roast it, to render it susceptible of magnetic separation.

The magnetic ores of Frontenac and Leeds, as well as Lanark and part of Renfrew, are assigned by Vennor to synclinal lines in successive terranes distinguished by lithological characteristics. A locality not referred to by Vennor, extends from lot 5 in the 11th to 5 in the 13th Con., reappearing on lot 3 in the 13th Concession of Portland. Whether this is all in one formation is as yet unknown. On lot 5, 13th Con., the ore is said to be of good quality. On lot 3, 13th Con. (485 ft. A.S.), a ferruginous quartzite, breaking with a diagonal cleavage, yields a varying percentage of ore. A somewhat similar ore on lot 2, 3rd Concession of Bedford, gave the following :—

	(1)	(2)	(3)
Fe	71.75	51.	26.40
Si	4.20	22.2	....
Al	....	6.8	....
CaO	1.60	....	....
S	.70	....	....
P	....	....	0.032
MngO	.25	....	....
TiO_2	....	....	.872

In the next range (552 ft. A.S.) on lot 3, 3rd Concession Bedford, a hard crystalline magnesian limestone accompanies the ore. At one opening the ore is disseminated in small grains through the rock, giving on analysis 23.70 Iron, Ph. .009. On the same lot, a pit 8 feet deep, shows a vein 3 feet wide, samples from which gave Fe., 63.50; Ph., trace; Ti., .080; S., 105. This range has not been explored any distance.

The succeeding range, proceeding northerly, is the 6th in Vennor's series, the elevations in which are from 500 to 600 feet A.S. The range extends about twelve miles in Bedford, and if extended to lots in North Crosby supposed to be in the range, is twenty miles in length. At its north-easterly termination in Bedford it is faulted between the 9th and 10th Concessions, and it would seem there are throws and displacements at several points near its south-west extremity. Here the ore is irregularly distributed through syenitic rock in bodies of more or less value. At 70 feet in depth, quantities of black tourmaline accompany the ore. About a quarter of a mile distant, the ore is found in dolomitic rock, in which it can be traced fully a mile, when the rock again changes character. The dolomite on the north wall gives place to hornblendic rock, and this changes again with the depth of the formation so as to lead to the belief that superficial overflows have changed the character of the overlying rock. In the further course of the range a remarkable development of schorlaceous schist enclosing crystals of black mica occurs on lot 9, 5th Concession. The ore mined on this range has presented varying characteristics, being remarkably pure during the earlier operations. It is for the most part highly crystalline, and has shown comparatively little sulphur until reaching the last few fathoms of work in the main shaft. The following assay is the mean of several analyses made for the Ohio Iron Co., of Zanesville, Ohio, the former lessees of the mine :—

Fe	62.73
Si	8.03
Mng	.58
Cao	.65
Mgo	3.45
P	.0115
S	2.41
Ti	Trace

Five drill cores taken from the main shaft averaged 110 feet each of mixed greenstone and ore. The latter gave, (mean of several analysis) :—

Fe	55.48
Si	8.04
Ph	.003
S	.0482
Mgo	7.23
Cao	3.15
Mng	3.52
Al	.67
Ti	Nil

At Black Lake, lot 8, 4th Concession with syenite footwall, greenstone hanging wall, the ore had the following average composition :—

Fe	62.03
Al	1.22
Si	2.56
Cao	1.17
Mgo	1.72
Mngo	.63
S	.273
P	.0149
Ti	.626

Between the range just noted and the next is a distance of 8 miles. The Eagle Lake range, the 5th of Vennor, probably extends from the K. & P. Railway westward some six miles, eastward 20 miles, approaching within 3 miles the C. P. R. line in Bathurst township. Analysis of this ore (Harrington's) gives :—

Fe	62.52
Al	.67
Cao	.33
Mg	.82
Ph	Trace
S	.07
Tio_2	3.28
Insol. res.	8.38

Apatite is disseminated in much of the ore in crystals and grains, the latter difficult of separation in the laboratory. The readiness with which titanferous ores open up when heated to redness and thrown into water, remarked by Auguste J. Rossi, makes it probable this ore could be concentrated to a high grade at moderate expense.

A large phosphate mine at St. George's Lake in Oso is the only mineral producer in a distance of 20 miles, lying chiefly within Vennor's 4th and 5th groups, until the Robertsville mine is reached. It is not to be inferred that this region is nonferriferous. On lot 17, 11th Concession, Olden, magnetic ore is found which gives on analysis (Hoffman's) :—

Ferrous oxide	28.975
Ferric "	68.46
Insol. res	1.364
No Titanium	.....

Magnetic ore is reported to be found on lots 11, 11th concession, 10 in the 4th concession and 7 in the 6th concession of the same township. West of this township brown and red hematite are found on lot 11, 8th concession, Kennebec within two miles of the C.P.R. line.

The Robertsville mine in Vennor's 4th division, A.S. 665 feet, is on lot 2, 9th concession of Palmerston. At 250 feet in depth the ore gave on analysis :—

Fe	57.17
Si	15.10
Al	.29
Cao	6.38
Mg	2.47
Mno	.40
S	.08

This mine was a producer for the Charlotte, N.Y., furnace, and it is said supplied selected ore, guaranteed to run 65 Fe, to a furnace at Pittsburgh. On an elevation on the lot adjoining (lot 1, 9th concession,) specular ore is found. Magnetic ore is found in the same range on lots 3, 5, 6, 10 and 11 in the 9th concession, 7 in the 10th and 21, 27 and 28 in the 11th concession of the same township.

West of Palmerston large bodies of magnetic ore are reported to be found in the townships of Clarendon and Barrie. No geological work appears to have been done on this range which is probably on the line of an extensive range of dolomite running north-easterly into South Canonto and thence into Lanark County. The extension of the Brockville and Westport Railway will serve to open up the property.

The magnetic ores of North and South Crosby are connected by Vennor with the feriferous magnesian limestones of Frontenac. He cautiously qualifies his statements however, as to the super-position and order of any member of the series. The principal locality is Chaffey's mine on an Island in Mud Lake, lot 9, 6th concession, South Crosby, which has been a considerable producer and the ore is said to be cheaply mined. The following are analyses :—

Ferrous oxide	10.03	.....
Magnetic oxide	60.57	69.77
Si	7.08	7.10
Fes_2	1.53	.....
Al	3.69	5.65
Tio_2	11.43	9.80
Ph	.....	.085
S	.82	1.52
Mgo	4.96	4.50

In North Crosby, ore from lot 27, 4th concession, gives :—

Fe	65.27
Al	1.33
Cao	.82
Mgo	.84
Ph	.007
S	.12
Tio_2	1.03
Insol.	5.25

and ore from lot 2, 9th concession, South Crosby.

Fe	63.2
Si	6.8
S	.02
Cao	3.3
Al. and Mg.	1.8

The work so far done by geologist and miner gives little information on which to predicate the future of the mining industry of this region. It has been profitable only to sellers of mines. Whether in the event of the establishment of iron and steel manufactures at Kingston, a permanent supply of good ore can be reckoned upon would seem to be unquestionable. But before accepting such conclusion on the basis of the meagre data at hand, prudence would dictate a very thorough examination of the ferriferous terranes which occupy so large a part of the district under consideration. The insane destruction of forest and soil by recklessly improvident free grant settlers, has removed hindrances encountered by Vennor, and rendered practicable the operations of the diamond drill, without the aid of which this extensive iron-ore district will never be able to satisfy reasonable enquiry into the permanence of its iron ore mines. Much may be done by roasting and concentration to place the discredited ores in the very front rank for furnace supply. Abundant water power at various points affords facilities for this enterprise, without recourse to which there is little prospect of any inquiry for dense refractory ores carrying sulphur, or phosphorus, or titanium, above objectionable points.

Peat Fuel.

MR. T. W. GIBSON, (Toronto)—The uses of fuel may be roughly classified under four heads:—

(1) Domestic—cooking, heating, &c.
(2) The generation of steam for industrial purposes.
(3) The smelting of ores and refining of metals.
(4) The production of illuminating gas.

The substances which have hitherto been almost exclusively employed for these purposes in Canada, as in most other countries, are coal and wood, either in their natural condition or in the form of coke and charcoal. The use of petroleum and petroleum products is not unknown in Ontario, particularly in the furnaces of steam boilers, and recent improvements in the method of combustion have rendered this fuel of importance where distance from the source of production does not unduly enhance its cost. Natural gas has also begun to be used and is now in employment on a limited scale, both for manufacturing, domestic and illuminating purposes, but we are exporting for consumption in a foreign country as much as, or perhaps more than we use ourselves, and the probability is that when we get ready to make use of it in earnest we shall find the supply very much reduced. Wood, as every one knows, is becoming scarcer every year, and increasing scarcity brings its natural result—increased prices. In some country districts in Ontario with which I am acquainted, the profusion of wood for fuel purposes which not long ago existed is now at an end. Of recent years such wood as maple has brought a higher price in the log than when cut into lengths for fuel, and the consequence is that farmers have sold their maple trees to saw millers and their tops and branches only to the users of fuel. These of course are inferior to the body of the tree, both for domestic and furnace purposes, and in such districts where wood was once the only kind of fuel thought of it is now a question as between wood and coal, with advantage in economy of price in some cases in favor of the latter.

Unfortunately, we have no coal in Ontario; at least none has yet been found in the southern portion of the province, though deposits of lignite are known to exist in the far off valleys of the Moose and Abbitibbi rivers on the Hudson Bay slope. The extent and value of these deposits are as yet unknown, as no systematic survey has been made with a view of determining whether or not they could be made available for economic use, but as they appear to occur in the drift it may be doubted whether they are likely to prove sources of important supply to the coal users of southern Ontario. At any rate they are yet far removed from communication and means of transport, so that were they ever so valuable they must for the present be left out of consideration. It is quite true that everybody does not agree with the geologists that we are below the coal bearing rocks in Ontario. It is natural to argue thus: we have been favored by Providence so highly in almost every other respect that it is almost inconceivable we should have been neglected in the matter of coal; consequently, we have heard in past years and still occasionally hear of discoveries of coal having been made in various parts of the province. Coal has been found at Collingwood, at Bowmanville and several other points. Some months ago a very valuable deposit was discovered—just to put the geologists to shame—not more than eight miles from the city of Toronto, and so precious is the bed to its owners that they have not yet been able to bring themselves to part with any portion of it, or even to raise it to the surface. No later than this week the Bureau of Mines was in receipt of a letter from a man who by means of a divining rod of his own construction had located a seam of coal eight feet in thickness in Western Ontario, which upon receipt of a suitable bonus from the government of the province he was willing to develop. The advisability of granting such a bonus, I need hardly say, remains under the government's most serious consideration.

But the lack of coal within our own borders leads to serious consequences. The coal we use comes almost wholly from the mines of Pennsylvania and Ohio, and whenever the gentlemen in control of these mines say "thumbs up" on the other side, thumbs have got to go up on this side. Were there even unrestricted competition among the producers of coal in the United States we could hope to get it in Ontario at the lowest price for which it could be profitably sold, but rings and monopolies govern the production and sale of this important article, and we are thus entirely within the power of foreign corporations who cannot be reached by Canadian laws, and who have "neither bodies to be kicked nor souls to be dammed." Nova Scotia, the only other possible source of supply, has, unfortunately, been shown by experience to be too far removed from our markets to admit of our drawing upon it for any considerable part of our requirements. In view then of the increasing scarcity and dearness of wood, and of our coal supplies being in a foreign land and the subject of an odious monopoly, we are, it seems to me, in presence of a situation which demands our instant and most careful consideration. How are our private and public interests to be protected?

There are those who hold out the hope of escape from the situation by means of electricity, that force which has already done so much, and which is to solve every possible problem of transportation, lighting, heating, smelting and power. Fuel is not required, they say, for the generation of electricity where you have sufficient water power, and in the undeveloped rapids and falls of the upland regions of Ontario, where the headwaters of the Muskoka, the Madawaska, the Petewawa, the Bonnechere, the Mattawa, the Severn, the Otonabee, the Trent, and many other streams take their rise, not to mention the immense potentiality of the falls of Niagara itself, lies the ultimate solution of the fuel question of Ontario. But while the grass grows the steed starves. There are many and great improvements to be made in the generatton, transmission and utilization of electric force before these distant sources of power can be utilized for the ordinary purposes of every day life, and some greatly superior means of transmitting electricity through long distances is especially required before that form of force can be expected to supersede for all uses the chemical energy evolved by the oxidation of carbon.

In older countries where wood has become scarce and coal for various reasons unavailable, recourse has long been had to peat as fuel, both in the ordinary air-dried form and in a manufactured condition after treatment by various processes. In Ireland, Scotland, Germany, France, Russia, Norway, Sweden and every other European country where peat is found—and it occurs in almost every country lying within the temperate zone—a large proportion of the peasantry have for centuries depended almost entirely upon peat for heating and culinary purposes. I do not need to give any description of the ordinary method of cutting and saving peat, which is practically the same in all lands. It is cut with spades or tools of special form into brick-like blocks, which after sufficient exposure to sun and air become dry enough to burn. This is the method employed where a peat bog can be entered upon and dug with safety and convenience. Where the peat occurs as it sometimes does in a pasty or mud-like mass of little consistency, it is dragged or scraped out to firm land, and upon evaporation of the contained water it forms an article of fuel considered even superior to that produced from an ordinary bog. Air-dried peat, from a good bog, properly cut and saved, is by no means a despicable article of fuel. There are those, indeed, who have used it in the old land who do not hesitate to claim for it an equality with coal or wood. Doubtless, however, one of its principal advantages to the poorer people of European and other countries is that it can be obtained at an expenditure of little more than their own labor. A family of growing boys with some assistance from the father or even the mother, can easily secure a year's fuel at the cost of a few days' or weeks' work. The fact that—as in Scotland—where wages have risen and increased facilities of transport have made coal available, the latter is preferred to peat, shows that on the whole common air-dried peat is not to be compared with coal as a fuel.

By various methods of manufacture, however, the crude article is very greatly improved, and brought more nearly upon an equality with coal. The principal objections to air-dried peat are its bulkiness and the considerable percentage of water which it retains. One ton of coal is said to be equivalent in evaporative effect of eight to eighteen tons of common air-dried peat, and ordinary specimens of the latter, even when considered dry and fit to use, contain not less than 25 or 30 per cent. of water. The object of manufacture is therefore to reduce the peat in point of bulk, and to free it from water. One method adopted to compass these ends has been tried by means of a great variety of mechanical appliances by inventors on the continent of Europe, in Great Britain and even in the United States. It consists essentially in reducing the peat as taken from the bog by grinding, triturating or macerating machinery, to a pasty, pulp-like condition, after which it is spread out upon the surface of the ground, marked off into divisions of suitable size, and allowed to dry. Sometimes the peat is moulded or pressed before being dried, sometimes air-dried before being compressed, and in some methods the drying is done by artificial heat. The result, especially where the drying is hastened by artificial means, is a hard, dense fuel approaching, or equal to, coal in specific gravity and capable of emitting intense heat. The cost, however, is considerable, and though occasionally especially favorable circumstances have conspired to render the experiment feasible and to enable the manufacture to be continued, sooner or later the expense has risen to a point beyond the returns and failure has been inevitable. Peat as it exists in the bog contains 90 per cent. and upwards of water, a large proportion of which it retains with the utmost tenacity, but all, or nearly all, of which must be got rid of in process of manufacture. To evaporate eight or nine tons of water in order to obtain one ton of fuel would on the face of it seem an impracticable undertaking, hence various plans have been attempted to overcome this difficulty. One is, after the living and (for fuel purposes) worthless growth on top of the bog has been removed and the bog drained, to pass a light harrow over the surface, after which the partially dry peat is collected and the process completed. Compression of the crude peat, whether by rollers or powerful presses, has also been attempted, but in connection with the pulping process has not proven very successful, as the pulping is done with much more difficulty and requires much heavier machinery when the material is in a partially dry state. Indeed with some stiff, dense peats from the lower portions of deep bogs water has not unfrequently to be added in order to effect a reduction to the necessary paste-like condition. Another system of manufacture is one in which the peat is passed through compressing machinery at the beginning of the operation, and without being pulped or having its original fibre destroyed, is dried by artificial heat and by strong pressure formed into blocks, cakes or cylinders of the desired size. The employment of artificial heat of course adds to the cost of the process, but it is doubted by some whether the water contained in the peat can be wholly expelled, or even eliminated to the required extent by pressure alone, and experience appears to bear out this view.

Peat is used not only in its ordinary form, but like wood and coal may be carbonized and reduced to coke or charcoal. Containing a percentage of carbon in proportion to its weight intermediate between that of wood and coal it gives on carbonization a corresponding weight of charcoal. Wood yields about 22 to 27 per cent. of charcoal and coal 75 to 90 per cent. while peat gives about 23 to 35 per cent. The condensed peat produced by the pulping process gives a much harder and denser charcoal than the ordinary air-dried article, the charcoal from which is so friable and light that it cannot be used in metallurgical operations. Peat charcoal has this advantage in common with wood charcoal over coke from coal, that it is much freer from impurities such as sulphur and phosphorus which exercise so injurious an effect in the smelting or reduction of iron. These and other impurities however, are not unknown in peat, and their absence or presence is usually dependent upon the constituents of the rocks and soil surrounding the bog from which the peat is taken. The decomposition of gypsiferous or pyritous rocks in the neighborhood of a peat bog would, for example, be sufficient to account for the presence of sulphur in the ashes of peat fuel manufactured from it. A bog in Wales containing copper pyrites was long used for the production of peat which was burned for the sake of the resulting ashes, many thousands of pounds worth of copper having been extracted therefrom. Peat usually yields more ash from a corresponding weight than wood and about the same as coal, but it varies greatly in this respect with the composition of the bog from which it is taken. Sand, lime and other similar substances are generally found in the ashes of peat, either in chemical combination or mechanical mixture, having in most cases been derived from the surrounding soil.

As might have been expected much more effort has been made to produce a good article of peat fuel economically in European countries than in the United States, where there is a comparative abundance of coal. In the latter country about twenty-five or thirty years ago coal was even higher in price than it is at present and much attention was directed to the utilization of peat, without however any lasting result. In Canada on the other hand, the fuel problem has been more pressing and at various periods processes have been in actual operation for the manufacture of peat fuel for a longer or shorter time. Recent events seem to indicate a revival of the interest in this question, for at the present moment there are three or four processes under way by which their inventors hope to solve the perplexing problem. In the neighborhood of Montreal and elsewhere in the Province of Quebec probably more persistent attempts have been made in this direction than anywhere else in Canada. Nearly thirty years ago Hodges placed his pulping machinery on a scow and manufactured peat at Buestrode, at we are informed a cost of 92 cents per ton, aad large quantities were consumed as fuel for the locomotive engines of the Grand Trunk Railway. A somewhat similar process invented by N. Aubin and improved by Hally was at work for a time under the management of the Valleyfield Peat Company, while Aikman of Montreal for many years has been experimenting and is still experimenting, with the process of manufacture which bears his name. Mr. Dickson of the same city has invented a process somewhat different in principle from any of these which he believes is now perfected and which the company he has formed intend to have in operation this coming summer in a bog on the Welland Canal where they have purchased a tract 3,000 acres in extent. I have here specimens of Aikman's, Hally's and Dickson's peat fuels, as well a sample taken by myself, from a small bog near Berlin, Ontario The last named sample is of the ordinary air-dried kind and being taken from the bottom of the bog, shows the deposit of shell marl underlying the bed of peat. Specimens of Aikman's and Dickson's manufacture—corresponding to these have been submitted to Prof. Ellis of the School of Practical Science, Toronto, for examination. He has tested them in a Thompson calorimeter with the following result:—

	Aikman Peat.	Dickson Peat.
Moisture.....	7.4	10.2
Ash.....	19.5	2.9
Heating Power....	5115 units	5280 units

Three samples of standard kinds of bituminous coal were also submitted to Prof. Ellis for purposes of comparison, which gave in heating power as follows :—

	Units.
Hocking coal, Ohio	6.820
Massilon coal, Ohio	7.425
Reynoldsville, Penn.	7.480
Mean	7.241

The heating power is expressed in metric heat units.

It will be seen that the two specimens of peat are nearly alike in heating power, and that in this respect they stand respectively in the relation of 71 and 73 per cent. of the mean value of the samples of coal. The average price of Reynoldsville coal at Toronto, where it is said to have control of the market for heating purposes, is $4.25 per ton, so that on the basis of calorific value alone these peats would appear to be worth about $3.00 to $3.10 per ton. The percentage of moisture does not materially differ in the two samples, being 7.4 and 10.2 respectively, and it is probable that experience would show the inutility of going to the trouble and expense of reducing the contained water below the smaller of these figures, as on exposure to the atmosphere the absorbent qualities of the peat would doubtless be sufficient to restore the percentage of water to at least this point. The greatest difference between the samples is in the matter of ash, in respect of which there is a marked inequality, one sample showing 19.5, and the other 2.9 per cent. This is of course due entirely to the composition of the bogs from which the samples were made, and has no bearing upon the merits of the processes of manufacture themselves. If the crude peat contains a considerable proportion of incombustible matter, no amount of trituration, compression, or other subsequent treatment will lessen it, and the plain inference is that in the manufacture of peat fuel, only those bogs should be employed which careful experiment shows to be reasonably free from inorganic substances. The proportion of ash contained in the more impure of the two samples, 19.5, is so high as to seriously detract from its value as fuel, and would lead to the conclusion that the bog from which it was made is not well suited for the manufacture of the article.

A recent letter from England gives an account of a process by which Mr. J. D. Brunton of London, is attempting to utilize the peat of Dartmoor, in the production of pig iron from hematite ore, of which abundant supplies exist in that district. He proposes to use, by a happy reciprocity, the waste gases from the blast furnaces to dry the peat, and the peat, apparently without being charred, to smelt the iron. It is estimated that 200 tons of peat will suffice for a yield of 100 tons of pig iron per week. The cost of iron ore is put at from 3s. to 6s. 6d. per ton, and the cost of the pig iron made under these conditions after ample allowance for contingencies, at £2 15s. per ton. If the selling price of the iron be put at only £5 per ton (a low price for charcoal iron) a profit of £2 5s. is expected to be realized. A square mile of the Dartmoor peat ground, is said to be sufficient to supply fuel for a make of 100 tons of pig iron per week, for 100 years. The application of the hot gaseous products of blast and other furnaces to the desiccation of peat is not however, original with Mr. Brunton. On the continent of Europe, kilns for drying peat have been constructed in which the hot waste gas of furnaces is driven in through the roof by means of a fan, made to descend through the peat, and thence to pass into a chimney communicating with the interior of the kiln at the bottom by two flues, one on each side. Kilns on this principle are said to have been first intoduced by Schlagel, into Austrian smelting works, and extensively adopted especially in French smelting works. The distinguished Swedish iron master, Gustaf Ekman, in 1856 erected a peat kiln upon this principle with, it is reported, an entirely favorable result. Ekman heated his kiln with the waste gas of a charcoal finery, which gas after having been used for heating pig iron, the blast of the finery, and an annealing furnace, was admitted into the kiln. Kilns constructed on the principle of taking in the hot gas at the top, are said to dry the peat more equally and quickly than those in which the gas enters at the bottom. Peat, and peat charcoal are used to some extent in the smelting and refining of iron in European countries, but where, as in Great Britain, mineral coal and coke are abundant, the latter are more generally employed. Dr. Percy, after a somewhat exhaustive review of the subject in his work on fuel, gives it as his opinion that "by a judicious selection of peat and suitable treatment, peat charcoal might, so far as relates to its capability of producing peat, serve as an efficient fuel for metallurgical operations." He adds that "the use of peat charcoal for fuel must in great measure depend upon the cost of its production, inclusive of the cost of the original peat, and its capability of competing in that respect with other fuel, namely, wood charcoal, certain kinds of coal, and coke."

The widest field of usefulness for peat in metallurgical processes would appear to be as material for the production of gas for use in the so-called regenerative furnace invented by the brothers Siemens, which has come so largely into use for smelting and refining purposes. To quote Percy again : "Experience on the Continent has conclusively shown that peat-charcoal may be used in some metallurgical operations with success ; also that peat may be successfully used for the production of gaseous fuel in a gas producer. Mr. C. W. Siemens, indeed, has informed me that putting its cost aside he should even prefer peat to coal for use in the producers of the regenerative gas-furnace. Now, the metallurgical operations to which gaseous fuel has been applied are already numerous, and it seems capable of even much wider application. The drawback in the employment of peat when high temperatures are required, resulting from its containing a large quantity of water, is obviated by converting it into gaseous fuel and subsequently condensing the moisture contained in the latter. So far, therefore, as the suitability of peat for metallurgical purposes is concerned, we may not unreasonably conclude that it could be widely substituted for coal with success." Percy goes on to state his conviction that peat can only compete with coal in countries where the cost of production and carriage of peat is relatively very low, and the price of coal relatively high, and that as regards Great Britain, circumstances must greatly change before these favorable conditions for utilizing peat are fulfilled. Percy's convictions as regards Great Britain is doubtless well founded, but the state of things in Ontario and Quebec is vastly different from that in the mother land. The pregnant fact that while there is abundance of coal in England, there is none at all here, changes the situation entirely, and conclusions which may be justly arrived at in the case of Great Britain are altogether inapplicable in our own. The cost of carriage which in England would be greater upon peat than coal, is here decidedly in favor of peat. Our only supplies of coal lying either a long way to the south in another country, or a long way to the east in another province, the item of freight charges must always be a heavy one, and must continue to add largely to the cost of the coal used here, while on the other hand once a really practical and economical system of manufacture was introduced, the peat bogs which are found in all quarters of Ontario and Quebec might be sources of fuel supply to surrounding districts at a minimum cost so far as freight charges are concerned.

There are very large areas of peat in Ontario. Mr. E. B. Borron who has penetrated through the wastes of the Hudson Bay slope tells us that in his opinion there are 10,000 square miles overlaid with peat from six to twenty feet in depth in that part of the Province. In the district between the Ottawa and the St. Lawrence rivers, in the vicinity of Lake St. Clair, in Elgin county, in the Parry Sound district, in Waterloo county, in Welland county along the Welland Canal, in the counties of York and Simcoe, along the line of the C.P.R., west of Lake Nipissing, and in many other sections of the Province are peat bogs of large area, and were they to become valuable as a result of a perfected process of manufacturing peat fuel the existence of many others would no doubt be revealed.

Peat fuel has been successfully employed for all the purposes for which coal and wood can be used. For some of these purposes it is owing to its bulk, less adapted than coal, as for instance in steamer and locomotive boilers, where economy of space is a great object, while for others, as we have seen, it is a very efficient substitute. Even in the production of illuminating gas it has been employed with good results, as for example in Dartmoor, England, where the prison at Prince Town is or was lighted with gas made from peat.

In conclusion I have only to express my conviction that this problem of the utilization of peat for fuel is one of the most important and pressing of the economic questions which are to-day engaging the attention of the people of Ontario and Quebec. Though the difficulties which be in the way of its solution have proven themselves to be many and formidable, the ingenuity of man I am convinced is equal to the task of overcoming them. I cannot think that the quest after a good and cheap peat fuel is the chase of an *ignis fatuus*, but on the contrary I cherish the hope that ere long we shall see a process in successful operation which will utilize our own resources, give us a first-class fuel at a cost below that of coal, and deliver us from the yoke of a foreign monopoly.

The Peat Industry of Canada.

R. W. ELLS, LL.D., Ottawa—The importance of the peat deposits which are found in all the provinces of Canada has long been recognized, and a number of attempts have been made from time to time to turn them to profitable account. Some of these have for a brief period given fairly satisfactory results, but all have, owing to various causes, gradually been abandoned. At present, however, there appears to be a growing interest in the question of their utilization, and it is to be hoped that, profiting by the mistakes and experience of the pioneers in the industry, some more practical scheme than has yet been in operation may be devised, so that the manufacture of peat, either for fuel or furnace purposes, may be placed on a paying basis.

This industry has a more important bearing upon the provinces of Ontario and Quebec from the fact that, while the inhabitants are there largely engaged in manufacturing pursuits, requiring a large supply of fuel, it has long been a settled question that in neither of these provinces can any natural supply of coal be expected. In Ontario this lack of coal for fuel may be, to a certain extent, met by the use of crude petroleum, burned in properly constructed grates, and the experiments already instituted in that direction have shown that, for heating and the generation of steam, this substance possesses very many admirable qualities. In Quebec, however, this source of supply appears to be unavailable, in so far at least as the researches in the Gaspè district, which may be regarded as our only oil field, have proceeded. Natural gas has also of late years entered the field as a possible competitor in the matter of fuel, more particularly in the province of Ontario, though wells giving a limited flow of gas have also been bored at different points in the St. Lawrence area, east and north of Montreal. This source of supply, however, does not meet the requirements of the case as satisfactorily as could be desired, owing doubtless, to some extent, to uncertainty as to its persistence, and also to the fact that it is unsuited to many purposes requiring a solid fuel. The fact also that the nearest available sources of coal fuel in eastern Canada are situated in the province of Nova Scotia, the nearest of which to Montreal being about 700 miles by rail, while the great areas of Pictou and Cape Breton are still more remote, must also be carefully considered in the discussion of such a question as the utilization of the peat deposits near home. True it is that the adjacent province of New Brunswick has a very considerable development of carboniferous rocks, and has by many been quoted as a great source of future supply of mineral fuel, but from a careful examination of that country it must be remarked that, owing to the thinness of the coal seams, rarely more than twenty to twenty-two inches, and the peculiar soft character of the coal itself, which unfits it for much handling, as also for other purposes for which a hard coal is now required, the utilization of this fuel must be, to a very large extent, merely local. The other remaining sources of supply, more especially for Quebec, are the distant coal-fields of the British Islands, from which, during a certain portion of the year, fuel can be cheaply brought owing to a low rate of freight, so cheaply, in fact, as to enter into close competition with the output from the Nova Scotia mines, and the deposits in the United States from which, owing also to canal transportation, fuel can be laid down at certain seasons almost as cheaply as from the lower provinces. Still the fact remains that freight rates both from Nova Scotia and the Pennsylvania fields are such as to make the price of coal fuel laid down in the manufacturing centres of Ontario and Quebec so high that many of the manufacturing and mining industries in both these provinces are seriously hampered, through the comparatively great expense involved in keeping our steam engines in motion and thus providing the power necessary to successfully carry on the various industries of the country.

The value of the peat deposits must however, after all be merely a comparative one. If it can be conclusively shown that a peat fuel can be produced, possessing let us say, 100 heat units and placed in the markets of Ontario and Quebec, at a well defined less rate as regards cost than 100 heat units of coal, taking the coals of Nova Scotia and the United States in ordinary use as the standard, then it should be apparent that our peat deposits are worthy of attention as an important factor among the manufacturing, or power producing agents of the day. To do this however, we must first of all consider several important features of the industry, such as the extent of our peat deposits, the calorific power of well prepared peat fuel, the convenience of handling and the advantages it possesses, if any, over the fuel at present at our disposal, and, in addition to this, and this is an especially important item, the cost of its manufacture.

In the utilization of our peat bogs we must, however, bear in mind the fact that other phases of the question possess an equal if not even a greater present economical value than that of fuel supply. For instance the question of the application of peat to sanitary purposes, for the reception and economic disposition of the sewage of large cities, is now being considered, and it has been ascertained that in this respect no substance yet known, possesses presumably greater or more valuable properties in this direction than this produce of our peat bogs, so long regarded as practically valueless. Further. a comparatively new industrty has come into prominence in connection with these deposits, which, in Holland and elsewhere, has already reached a very extensive development and which should also furnish handsome returns on capital in the country, viz., the manufacture of moss litter. This material from its great absorbent properties has been found to surpass all other substances in the utilization of stable waste, and for promoting the comfort and cleanliness, and as a consequence the health of all animals these kept. So great is the importance of this industry, as yet comparatively unknown in Canada, that the peat bogs of Holland are now supplying the markets of London and New York, with this prepared moss litter, with a demand apparently unlimited and at a price quoted on the London market of 21 to 26 shillings per ton, according to quality, which should furnish highly remunerative results.

In the report of the Geological Survey for 1845-46, attention was directed to the Canadian peat deposits, and the results of the investigations on this subject by Dr. T. Sterry Hunt appeared in subsequent reports. Among those of special importance are the articles in the geology of Canada, 1863, and in the report for 1866. In the pamphlet prepared for the Paris Exhibition, 1878, further information is presented more particularly relating to the trials carried on in the deposits east of St. John in connection with the Hodge process, and at St. Hubert, in the county of Chambly, at which places very extensive bogs of excellent peat occur. A very considerable quantity of prepared fuel was produced at these places aggregating in 1875 about 13,000 tons in all, a small amount being used for domestic purposes while the rest was employed by the Grand Trunk Railway for their locomotives. Changes in the company, however, appear to have acted unfavorably as to the continuance of the industry, and since that date but little has been done in this direction. A small quantity of prepared peat was also produced about the same time near Port Lewis, in the county of Huntingdon, as well as at Newtonville, near Port Hope, in Ontario. Unfortunately no reliable data as to the cost of manufacture at either of these places is at hand and no subsequent developments appear to have taken place.

While the peat deposits of Quebec and Ontario are known to be very extensive, the greater part of these have hitherto remained untried. Among the best known may be mentioned for the latter province, the vicinity of the Caledonia Springs, lying to the south of the Ottawa, in the township of Caledonia, county of Prescott, and certain bogs in Clarence, Cumberland and Gloucester, the latter in the county of Carleton. Of these, that nearest the city of Ottawa is the Mer Bleu, which consists of two long peat bogs, separated by a narrow ridge of higher land, and comprising in the two an arca of not far from 5,000 acres. These bogs were sounded by Mr. James Richardson of the Geological Survey staff, and shewn to have a depth in places of over twenty feet, the depth elsewhere ranging from five to fifteen feet. Three other large areas from 1,000 to 3,000 acres each occur in the townships of Nepean and Goulbourn adjoining, while other extensive bogs occur in Huntley and Westmeath. The depth of peat in these deposits varies from eight to over fifteen feet. Further south in the direction of Cornwall, bogs are found in Osnabruck, Roxburgh and Finch, so that it is easily seen that a practically inexhaustible supply of the material is found in the almost immediate vicinity of the Ottawa and St. Lawrence and in close proximity to the leading manufacturing centres. In Western Ontario also peat bogs have been noted at many points, as in the vicinity of the Welland Canal and in the western portion near to the St. Clair river, as also in the counties of Simcoe and York, and further west along the line of the Canadian Pacific Railway, north of Lake Superior, as well as on the route between that lake and Winnipeg.

Inexhaustible supplies also occur in the province of Quebec, as in Chambly, at St. Hubert and at St. Brigide, where works have alrcady been in operation. On the line of railway from Arthabasca to the St. Lawrence opposite Three Rivers, at Bulstrade, a bog was also formerly worked quite extensively, the product as air dried peat being used on the Grand Trunk Railway; as also in Huntingdon, Champlain, Lacolle and Sherrington, where a very thick deposit of excellent peat, particularly worthy of notice, is found. East of Valleyfield also and in St. Dominique extensive deposits occur; while on the north side of the St. Lawrence these are known in the townships of Grenville, Harrington, Mille Isles, Ste. Anne des Plaines, St. Sulpice and Lavaltrie and St. Maurice. On the lower St. Lawrence peat bogs are found at River Ouelle, Isle Verte, Daquame, Matane, Macnider and other places, while on the Island of Anticosti an immense bog, estimated at nearly 200 square miles in extent, occurs on the south-west coast, much of which is reported of excellent quality. From this brief enumeration of a few localities it is easily seen that the quantity of this possible fuel in Quebec is also practically unlimited.

Peat bogs are all of vegetable growth, consisting for the most part of the decomposed remains of plants and mosses chiefly of the genus sphagaum, which has apparently filled up the basins of shallow lakes. The deposits are frequently underlaid by a layer of shell marl which has constituted the original lake bottom. The peat bog frequently carries a growth of trees, often of tamarac in a stunted condition, with various heath plants, which by the decay, both of their stem and rootlets, help to swell the organic constituents of the moss. In bogs of a good depth the peat may be divivided into three classes, viz., 1st, the green living and growing surface, 2nd, the intermediate zone in which the remains of the plants are well defined but which is capable of furnishing an excellent peat for certain purposes, and 3rd, the lower and fully digested material in which traces of organic life are comparatively rare, which possesses a rich black or brown color and when frec from inorganic matter, furnishes a fuel of very excellent quality.

In character also peat varies somewhat owing to the nature of the underlying rocks. Thus moss peats are generally found in rocks nearly free from lime such as granite or other strata rich in silica, while grassy or sedgy peats are more frequently found in calcareous districts. In the ripest or most thoroughly formed peat, the decomposition of the organic matter has reached the last stage, the result being a dark brown or black homogeneous mass, comparatively heavy and dense. This when moist is firm, sticky and coherent like clay, and can be readily cut and moulded into any shape, and when dried it is hard having on cut or burnished surface a lustre like pitch or wax.

In the development or exploitation of a peat bog for fuel it would apparently be advisable to make use of that portion which is purest from organic remains, viz., that which occupies the lowest of the third strata just described; and in former experiments upon the large scale possibly it may be found that some of the lack of success that attended these efforts was due to the attempt to utilize an inferior portion rather than that most adapted to the manufacture of the best fuel. In this connection it may be wise to consider also that it is possible now to utilize the upper portion of the bog as well, in the preparation of the moss litter, though the only attempt to develop this industry in Canada, in so far as I can yet learn has been in New Brunswick where several years ago operations were begun in a peat bog about fifteen miles west of St. John at a place named Musquash. The promoters were capitalists from St. John and St. Stephen, and a brief account of their operations will be found in the Report of the Geological Survey, 1889, by Mr. R. Chalmers. No attempt, however, was made to manufacture a peat fuel owing presumably to the facilities possessed at this place for obtaining bituminous coal from the adjoining province of Nova Scotia, the freight from the mines of Cumberland county being low. In order to shew, however, what has been attempted in this direction, I may here quote a brief extract from the report just referred to. "This article, 'moss litter,' is used in stables as bedding for horses, &c., and owners of studs in the principal cities of the United States have been looking for a material of this kind prepared from the peat found on this side of the Atlantic. What they require is a spongy moss, sufficiently light and porous to be an absorbent of the liquids and ammonia which collect in stables, and which after being used in this way would make a fertilizer for gardens, &c. The company having purchased the bog at Musquash, are now, 1889, erecting buildings and machinery there for the preparation of the article. They claim that the peat moss found in this locality is well adapted for the purpose intended, and is equally as good as the German moss litter. Hitherto a large amount of time and capital has been spent by the Musquash Co. in experimenting and testing the suitability of the different grades of peat or boggy material obtained here for the purpose in view, and it has been found that what is about half decayed, *i.e.*, sufficiently so to be changed to a dark color and rendered somewhat short in the fibre, without being absolutely brittle, is the best. This kind of peat is not found in the upper or living part, nor yet in the deep lying rotted material, but between the two, where the mosses and rootlets are partially decomposed and the fibres strong enough to prevent the moss from crumbling to pieces. The chief process in its preparation is that of depriving it of the water, of which it contains from ninety to ninety-five per cent. This is effected partially in the pit by a machine called a plunger. The moss is then brought by tramways into a building and subjected to great pressure by passing between heavy rollers, and lastly the residual moisture is driven off by evaporation, after which it is packed into bales for shipment."

In the attempt to manufacture a compressed peat fuel of the first quality, or even an air dried product, it would be well therefore to take into careful consideration the question of utilizing this second layer of say four to five feet for the purpose first mentioned, since it should, if properly managed, prove equally a source of profit as the manufacture of the fuel itself, while it would enable that portion of the bog best adapted for the latter purpose to be more readily and economically operated.

Two great drawbacks have hitherto been found in regard to the utilization of peat as fuel on the commercial scale, viz., the great bulk of the air-dried variety, thus requiring great storage facilities, as well as excessive charges for transport, and the contained water, which even in the best air-dried qualities reaches 18 to 20 per cent. This contained water must of course greatly diminish the calorific value of the fuel, and it is the practical impossibility hitherto experienced of reducing the great percentage of contained moisture without very considerable expense which has apparently interfered with the successful economic use of the fuel in our manufactories and locomotives.

In the matter of contained water air-dried peat ranks on a par with the best qualities of air-dried wood but possesses this disadvantage that it contains a much greater quantity of ash, and also has a marked tendency to absorb moisture very readily, a feature which it is apparently very difficult to guard against. In the digging of peat also the precaution must be taken to provide against the action of frost, since if frozen when wet its coherence is destroyed and it becomes useless as an air-dried fuel.

It is evident from a careful examinination of the tests already made of our peat deposits that the objections already mentioned in regard to the air-dried product practically exclude it from the market unless for purely local consumption, and the future course of the industry as regards the peat question must be along the lines of producing cheaply a thoroughly good compressed article. In this connection, due care must first of all, as already suggested, be paid to the quality of the raw material used. For while simple pressure will reduce the peat to a much smaller bulk, if the material is originally light and porous, its natural elasticity will tend when once the pressure is removed to restore it to its normal condition. It has also been found in practice hitherto that the machines employed, no doubt in some cases owing to a lack of proper preparations of the raw material before subjecting it to pressure, have failed to thoroughly remove the contained water; and this has, of necessity, if a drier article is required, to be removed by the application of artificial heat at a considerably increased expense, the value of the fuel however being found to be greatly increased by this action. As regards the specific gravity of the peat this depends principally upon its position in the bog, and when uncompressed ranges from .25 to .9. In deep bogs a first-class peat of dark blackisk and brown color and earthy fracture should have a gravity of .6 to .65. In carbon contents it ranges from 51 to 63 per cent. of the organic matter, its quality being due to its density and ripeness. From a series of experiments conducted by Prof. Johnson of the Yale Scientific School it would appear that, weight for weight, the ordinary qualities of peat do not differ very greatly from wood for heating purposes. By compression its heating properties are very greatly increased. Thus it was found that while a good peat, cut and air-dried, had a heating value of 80, the same condensed and containing ten per cent. of water had a value of 1.48, and made into peat charcoal the value was increased to 1.73. Compared with wood this value was found to range from .50 for poplar to 1.18 for summer oak.

As compared with anthracite tests made by the Water Department of Brooklyn shewed the ratio of peat to this fuel to be as 1 to 2.25 and a table prepared by Prof. Johnston, showing the comparative composition and quality of peat, wood and anthracite is as follows:—

	Carbon.	hyd.	ox. & nit.	ash.	water.	sp. par.
Wood..	39.6	4.8	34.8	0.8	20	.75
C. peat.	47.2	4.9	22.9	5.	20	1.20
Anth ..	91.3	2.9	2.8	3.	..	1.40

In regard to the manufacture of coke from peat it may be remarked that its value has been known for many years. Thus we learn that as early as 1727, patents were issued in England for the smelting and manufacture of iron with this fuel, and in the Hartz Mountains in Germany peat charcoal was used in metallurgical operations on the large scale in 1735, but it is stated that owing to the novelty of the process and through the agency of certain parties interested in keeping up the price of wood, its use for this purpose was discouraged. Coke from simply air-dried peat is found to be too tender for use in the blast furnace, but that from compressed peat was regarded as equally as good for this purpose as that from bituminous coal. The results of its use in the blast furnace are however conflicting as regards its value, this probably being due to differences in the quality of the coke employed. From a number of trials made in Ireland it was held that the quality of peat coke was equal to that of gas coke while the total cost according to Vignolis process, in which the carbonization was effected by means of superheated steam, was about two dollars per ton (8s. 4d.) with the price of raw peat at four shillings. Three tons of peat were required to produce a ton of coke, the expense being reduced very considerably by the utilization of the by products such as wax, tar, gas, &c.

Probably in no country has the manufacture of peat fuel and charcoal been more successfully carried on than in France, and in the earlier reports of the survey some valuable information will be found as the result of the study of the industry by Dr. T. Sterry Hunt at the time of the French Exhibition in 1855. Among those who have brought the industry to a high pitch of perfection may be mentioned Mons. Brughat, and a few extracts from a short pamphlet of his on the subject may here be given. After summing up the various analyses of peat, wood, coal and charcoal, he says that the calorific power of compressed peat made according to the Chailleton process as compared with wood and coal is in round numbers as follows:

Compressed peat varying in value according to the process of manufacture and containing 10 per cent. of water from	3 to 4
Peat charcoal.....	4½ to 5
Bituminous coal, 1st quality	5
Anthracite	9½
Wood charcoal	1 to 1¾
Wood, with 25 per cent. water.....	¾ to 1½

In a special report by Dr. Harrington, of McGill University, prepared in 1871 in connection with the peat deposits of the province of Prince Edward Island, assays were made of several of the peat fuels obtained from the bogs east of Montreal. The samples are from air-dried material and the assays are as follows:

	1	2	Mean
Water (hygroscopic).....	14.82	15.10	14.97
Volatile combustible matter....	60.10	59.10	59.60
Fixed carbon.....	21.80	22.60	22.20
Ash.....	3.28	3.30	3.24

The assays of two samples of Hodges peat which had been kept within doors for a year, are also given:

	1	2	Mean
Hygroscopic water	16.80	17.31	17.06
Volatile combustible matter....	49.80	51.65	50.72
Fixed carbon	2g.90	25.00	25.95
Ash.....	6,50	6.03	6.25

The excellent paper published in the last bulletin of the Bureau of Mines, Ontario, on the subject of peat, sums up very concisely most of the information contained in the several government reports, and supplements this with a great variety of facts bearing on the general aspect of the question. From this it would appear that the recent tests with locomotives and stationary boilers did not give as good results as were anticipated, the percentage of power to cost being very considerably lower than that obtained either from the use of bituminous coal or even wood. This would show conclusively that the quality of the peat employed was far from being what it should be, judging from the table just quoted, containing presumably an excess of water, greater even than should be found in a first-class air dried peat. It is possible this peat was obtained from a portion of the bog not representing the best quality for fuel purposes, and thus shows that in the attempt to place this industry on a thoroughly satisfactory commercial basis great care must be exercised in the selection of the raw material. As Brughat has pointed out, repeated failures attended the attempts in this direction for some years both in France and Germany, and it has been only by a careful study of all the conditions, not only as regards the material itself, but the methods of manufacture, that he claims the success which he has at last attained. It seems difficult to realize the statements as to profit given by Brughat as stated in the bulletin of the Ontario Bureau. But the claim he makes that one and a quarter tons of peat coal are equal to one ton of the best English coal for ordinary steam purposes and for domestic purposes under proper conditions of draft and grate construction the value is equal ton for ton, deserves a careful consideration of the methods of which these results may be attained by those interested in the furtherance of this industry in Canada. With coal selling at $3.50 to $6.00 per ton, which may fairly be assumed as the price paid in Quebec and Ontario, in many places for even Nova Scotia slack for boiler use, a com-

ressed peat capable of production at half that price should e profitably employed; while for house purposes where he price of bituminous coal reaches $6.00 and even in)ttawa $8.00 per ton, a first-class peat fuel should return ery handsome profit to the producer. The great extent nd apparent value of the peat deposits in this country, ogether with the very large present consumption of coal nd the high prices paid therefor, would appear to warrant he most exhaustive series of experiments tending to solve atisfactorily the economic aspect of the question, not only n the production of a fuel suitable in every way for lomestic and steam purposes, but for employment also in he reduction of our iron ores and for the various other pro- esses concerned in the manufacture of iron and steel. In his connection we may be permitted to quote again from Brughat. "It is especially in metallurgical works hat very great economy results from the use of ur peat. We will attain among other things, both ron and steel of better quality, than by the employ- ent of either coal or coke, since the coke therefrom con- ains no sulphur as has been proved by numerous analyses ade with the greatest care, as well as by practical tests onducted in our forges and blast furnaces, both in the anufacture of cast steel, cutlery, gun-barrels and in he casting of the metals.

In a paper by Prof. N. S. Shaler of Harvard Uni- ersity, published in the tenth annual report of the U. S. eological Survey, on certain fresh water deposits in that ountry, he remarks on the subject of peat, that in his pinion a good peat fuel could be produced at a cost of $5.00 per ton with labor at $1.50 per day. In view of he results already obtained in the attempts to work the anadian deposits, as quoted in the Geology of Canada 863, and from the statements contained in Brughat's reatise, as well as those obtained from the manufacture of is fuel in Ireland, we believe that a first-class article an be produced in Canada at a much less figure than he tates. Such results, however, will only be obtained y avoiding the mistakes already so often made by those ho have attempted the solution of the problem, and by aying due attention to the quality of material employed s well as to the use of the best appliances for compress- g and preparing for market a peat containing the least ossible percentage of ash and moisture, and in this way btaining results which will place this material more early on a par as regards effectiveness with our best uality of bituminous coals.

MR. DICKSON—I have very little to add to what has lready been said except to say that I have a company rganized in Toronto and we have purchased the Welland og, and are getting machinery to turn it out on a large cale. These here are simply samples. It is the inten- ion to turn it out in large blocks about three inches in iameter for steam generating purposes, and about two nches for domestic purposes. We find by experiment hat we can make fuel for $1.50 a ton. The moisture is riven off entirely by pressure, and reduced to about 10 er cent. We find the upper portion, that is after the oss had been removed, nearly as good fuel as the lower ortion; and those samples there are made from the pper entirely.

The Welland Canal runs through the bog which we ntend operating during the coming season, which affords xcellent facilities for shipping; and besides that there re several railways adjacent. It is the intention of the ompany when started to start other similar operations in he Province of Quebec where it is expected it can be anufactured for $1.50 a ton.

MR. BELL—What do you think you can put it on the arket for?

MR. DICKSON—Oh, well less than coal.

MR. DOUCET—I would like to ask if this sample has een subjected to water.

MR. DICKSON—Yes.

MR. DOUCET—What was your experience?

MR. DICKSON—It is proof against all ordinary oisture, but if soaked will absorb a certain percentage. t has been soaked for several hours, but after being aked for 24 hours it has absorbed about 20 per cent. of ater.

MR. DOUCET—Is this pressed by heat?

MR. DICKSON—No; perfectly cold.

MR. DOUCET—Where does this peat come from?

MR. DICKSON—That is Quebec peat, from the hamplain bog. I have several specimens from Welland nd Berlin. Here is a sample we pressed and which akes nice fuel.

MR. GIBSON—That Hally (?) peat has not been ressed. It is simply pulp peat dried by evaporation.

MR. DOUCET—Has this ever been burned?

MR. DICKSON—I don't remember the analysis; but think less than 3 per cent. 2.09 per cent. I think, was sh. It is not pressed by hydraulic pressure.

MR. BELL—I would suggest that Mr. Dickson at some uture time should give us some details of his process.

MR. DICKSON—If I had had longer notice I would ave been glad to do so to-day.

PROF. HARRINGTON—I have been interested in his subject. I have had some little experience a good many years ago with it, and quite agree with most of what has been said. I think there is no reason why we should not utilize peat in various parts of the country.

Members Dine Together.

In the evening about twenty-five members sat down to dinner in the Windsor Hotel. Capt. R. C. Adams presided. The proceedings were entirely *sans ceremonie*, the evening being spent in songs and impromptu speeches.

CAPT. ADAMS, in opening the proceeding said:—It is very well for us to try and reform the constitution of the association, but I think that it is more important for us at a banquet like this to attend to our own constitutions. And I think also that while it is well for us to enlarge our brains, it is still more important for us to enlarge our hearts; and I look on this social feature of the association as perhaps the most valuable. What we gain by rubbing up against each other in hearty association does us perhaps more good that all we can learn from our very wise papers. I think too, that we are very fortunate in being miners, because after a somewhat extensive connection with the world I have come to the conclusion that the most interesting people in the world are the miners. I do not think there is any profession which gives a man so wide a range of view as that of mining. I am told that in McGill College the very best course of instruction is that of mining engineering, because it brings one into contact with so many different branches of knowledge. The miner unlike the sailor has to be master of all trades and jack of none. I never heard of but one fault laid to mining; and it was alluded to by a newspaper, which said that George Washington would never have obtained his record for veracity if he had been a mining engineer, and had had to send in a weekly report of progress. There has sometimes been a little doubt as to the veracity of the mining engineer, I admit; but the profession is a romantic one. The mining engineer has in his vocation a great deal that is calculated to stimulate his imagination before him; and it is not a matter of wonder if he is tempted to go a little ahead of the fact. But very often the facts get ahead of the imagination.

I think too, that miners are not only the most interesting people, but also the most useful. They are the pioneers of civilization. In a new country the hunter goes first, marks out a little track, and finds a little bit of stone which he brings in. And then the miner goes out and pitches his camp and civilization follows. A settlement springs up, and you will find that it was the miner who was the pioneer. It was owing to the hardy miner of '49 that the great Pacific slope was settled up, and that that region has become the Garden of Eden of the modern world, and that the great Pacific railroads have crossed the continent, and been the means of building up homes for millions of farmers. It was the miner who was the pioneer of all this western civilization. So that we may claim credit for our industry as having been not only productive of interesting men, but also as having been one of the great civilizing forces of the age.

It is well for us to take a little praise to ourselves, especially in a profession where so much is unappreciated and looked upon as a matter possessing little sentiment. You remember the story of the clergyman, who at a funeral in Colorado, attempted to make a quotation from one of the poets. He desired to say: "Death loves a shining mark;" but he got a little mixed, his feelings overcame him, and he said: "Death loves a mining shark." It is said that three-fourths of the congregation got up and left the church. feeling that it was a personal reflection. I think gentlemen that it is well for us to have these occasions of good cheer, for we all occasionally have our dull moments even in that exciting pursuit of mining. We have not prepared any set list of toasts for to-night. We want to have a happy family and informal gathering; and we are going to begin right up here with the mining men, and then with our guests, and ask each one of them to give us his wit and wisdom.

Captain Adams concluded his remarks by reciting in splendid style the following lines entitled "The Prospectors Soliloquy."

"To sink or not to sink; that is the question;
Whether 'tis better in the prospector to sell
The highly metalliferous cropping for a song
Or, using muscle, dig her down
And thus by perseverance strike it. To sink, to work
No more; and by that sinking, strike a lead
Of gold or silver, or the finest copper glance
That luck is heir to. 'Tis a consummation
Devoutly to be wished. To sink, to blast
To blast, perchance to "bust;" ay, there's the rub;
For at the depth of ten feet what base may come
When we have shoveled off the uncertain top,
Must give us pause. There's the respect
Which makes calamity of a prospect hole;
For who can tell what "pinch" may come below
The argentiferous stuff? Component parts of lead,
The metalliferous decomposed, conglomerate
Corruption of nature, all broken up, perchance;
The insolence of luckier blokes; and then the chance
The miner takes by shafting,
When he himself might be much better off
By simply waiting. What would we not do
But that the dread of something yet unseen—
The undiscovered pay streak (perhaps not there)—
The argentiferous conundrum—puzzles the will
And makes us rather raise the monument we have
Than open up the ground we know not of.
Thus prospecting doth make cowards of us all;
And thus the prospects of a big bonanza
Are sickered with some dark and cussed doubt,
And speculators in a surface prize
With this regard their interest turn aside
And lose, perchance, a million."

The evening's entertainment of song and sentiment was contributed to by a number of gentlemen present.

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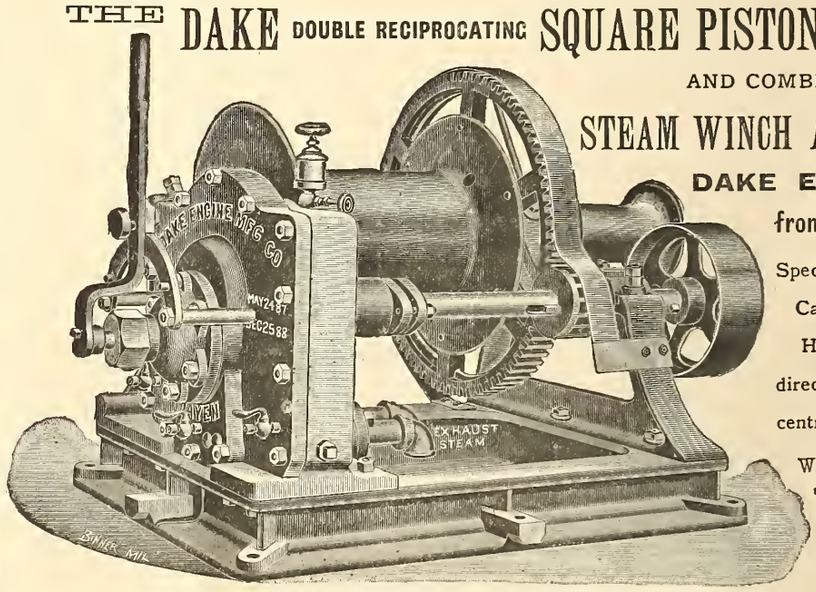

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Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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SOME REMARKABLE RESULTS IN GOLD EXTRACTING.

New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. & Mining Co, Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

W. D. Sutherland, Secretary of the Salisbury Gold Mining Co., of Nova Scotia, after having over 4 tons of ore treated by the Crawford mill, says: "Sample of the tailings taken during the run showed by assay an equivalent to 0.033 oz. to the ton. This evidence of the capability of the Crawford mill to extract all but a trace of the gold which the ore may contain must be considered of importance by all who are interested in the question of improved methods of milling gold from the ore. The test alluded to was made under the supervision of our company through trustworthy agents."

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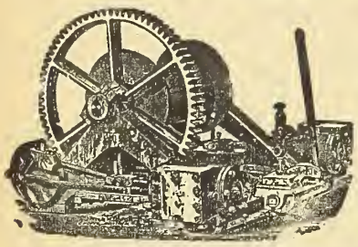

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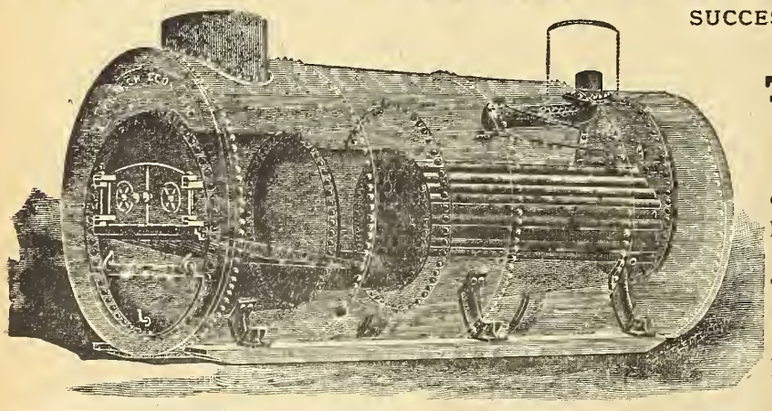

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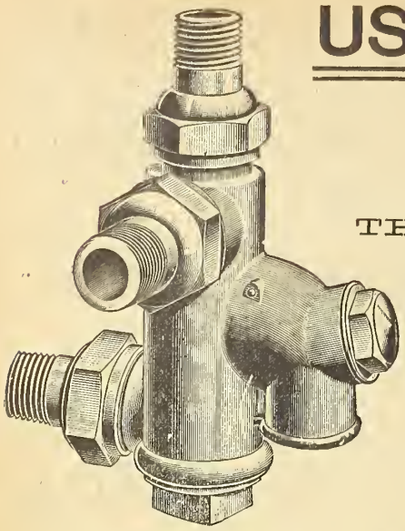

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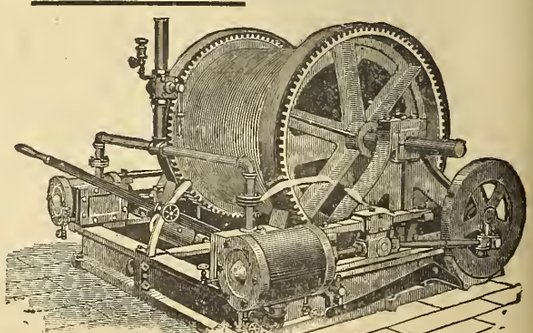

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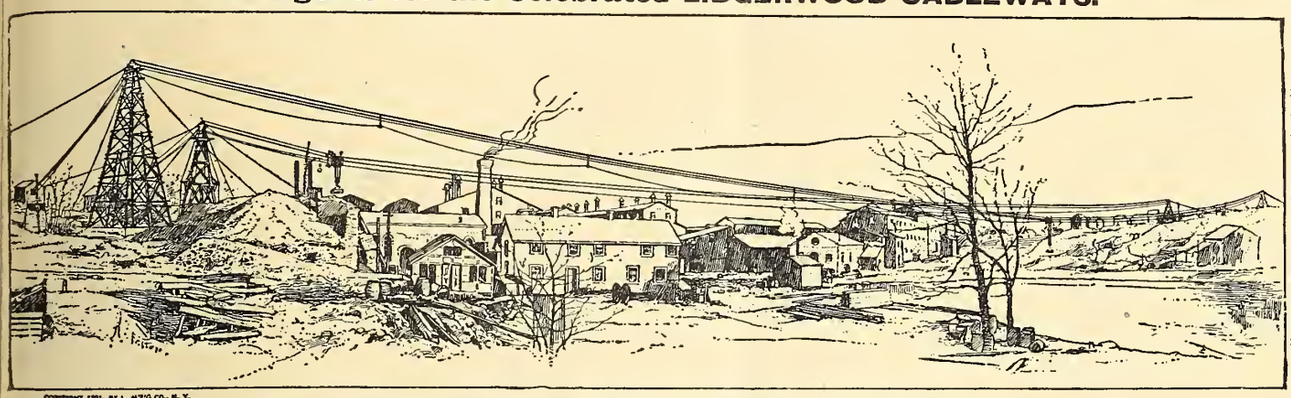

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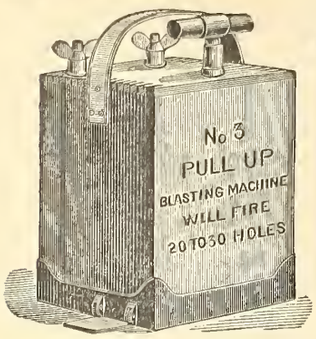

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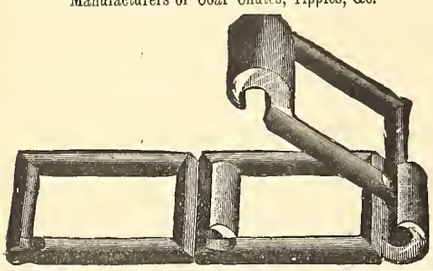

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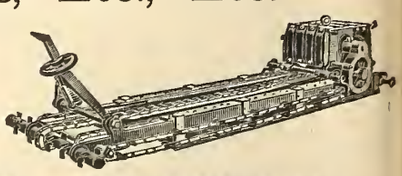

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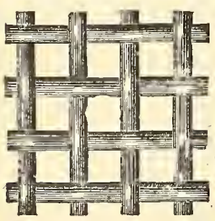

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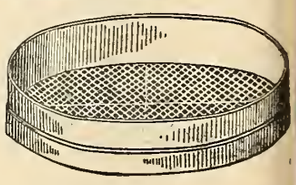

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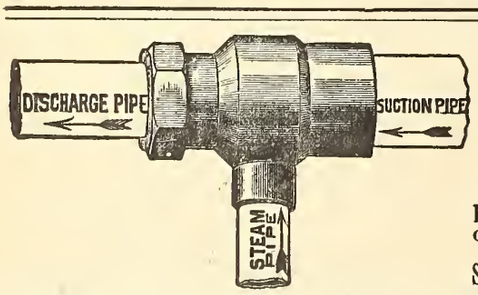

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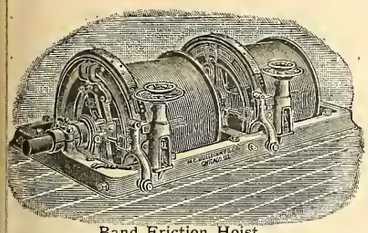

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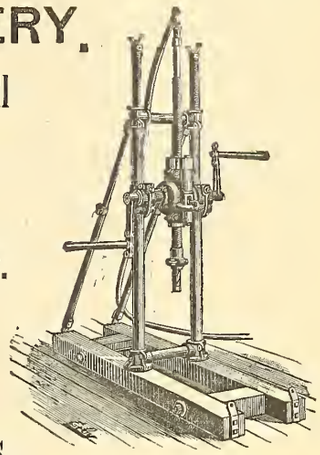

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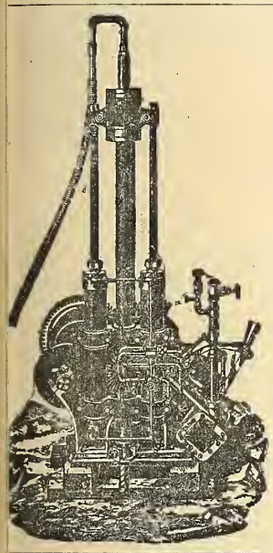

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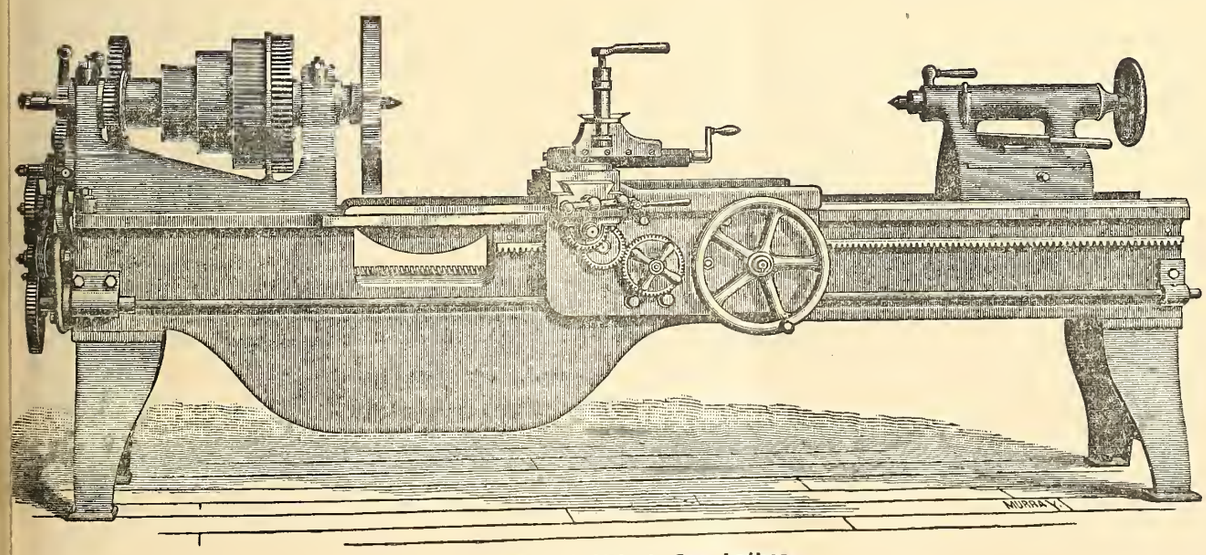

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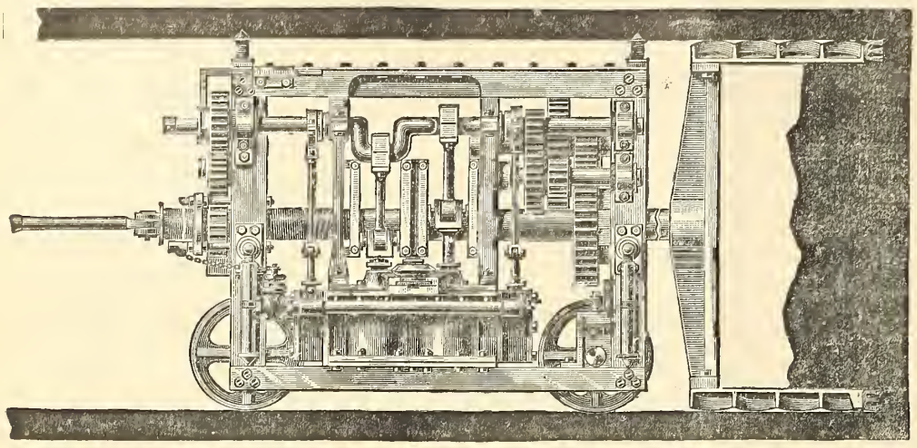

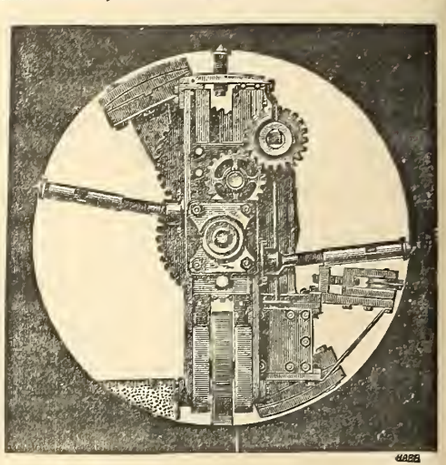

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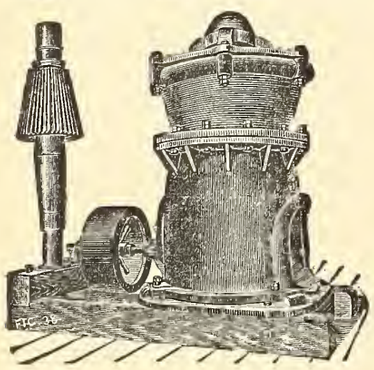

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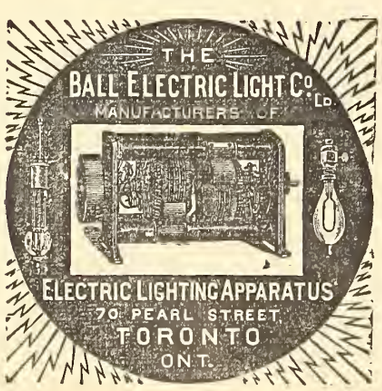

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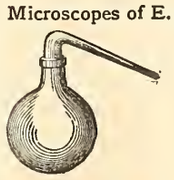

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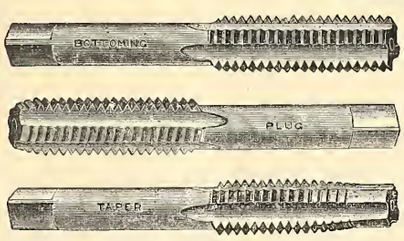

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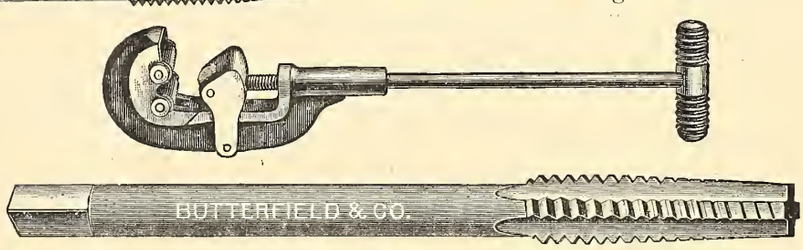

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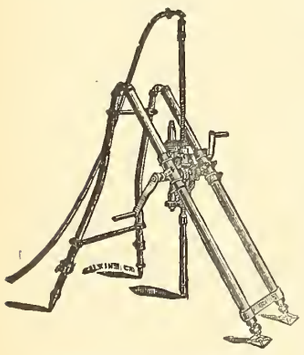

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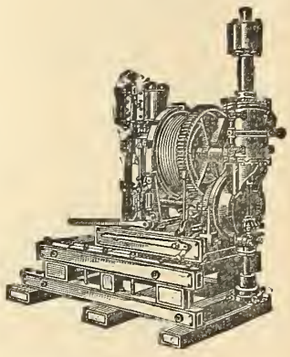

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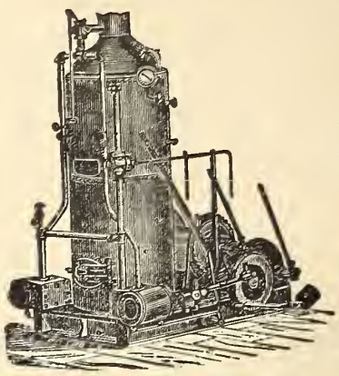

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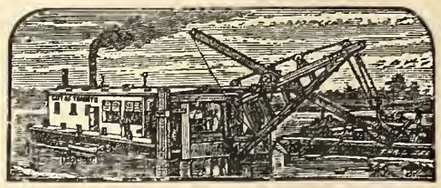

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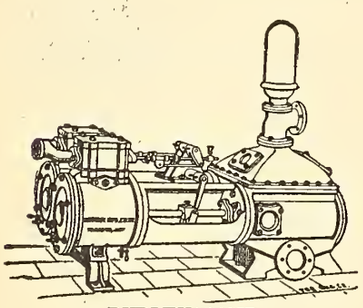

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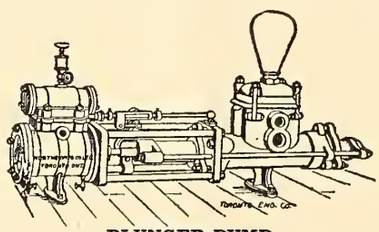

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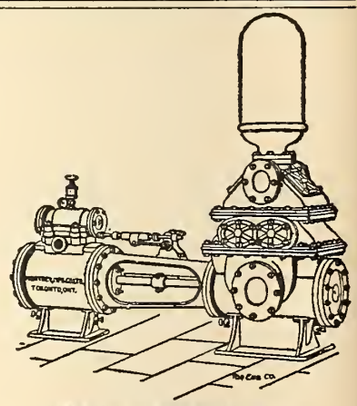

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OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

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THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEB EC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The Lake View Mining Syndicate, Ltd., of London, G.B.

From time to time it has been the policy of the REVIEW to advise caution on the part of both home and foreign investors when some mining scheme has been brought forward the record of which has not warranted the glowing statements of prospectuses issued.

It is fairly open to question whether to such category belongs "The Lake View Mining Syndicate, Limited," an English incorporation formed to work gold mines at Waverley, Nova Scotia, and the prospectus of which has lately been issued in London.

The British courts, in various cases of late, have held that the directors of such companies are personally responsible for the accuracy of the statements contained in the prospectuses, and the object of this article is to call the attention of the directors of this scheme to one or two matters into which it would be well to inquire before sending the documents out broadcast.

The object of the Syndicate, as set forth in print is to acquire "a lease (granted to Alonzo A. Hayward for the term of two years, from September 7th, 1892) of the entire plant, personal property, and gold mining areas, owned by the Lake View Mining Co., Ltd, a company organized under the laws of Nova Scotia, Canada; also the option to purchase the said property for the sum of one hundred thousand dollars, about £20,000, at any time during the term of the lease." The lease requires a payment of 10 per cent. of the gross output, 2 per cent. to the Nova Scotia Government for royalty, and 8 per cent. to the owning company, for rental, or additional royalty.

The prospectus says: "Nova Scotia mines having been comparatively little worked, the public are (*sic*) scarcely aware that it is a gold bearing country." Are there many Londoners agreeing with the above? Some, at any rate, will remember the *New Albion Co.*, *The British and Colonial Land and Mining Co.*, and other companies of both more recent and older dates, and well remember that Nova Scotia gold was the cause of their being.

Another statement to catch the eye is: "The mine has been thoroughly proved * * The Government returns show that 16,226 tons of quartz taken from this mine yielded 11,034 ozs. of gold, or an average of 16½ dwts. per ton." The phraseology of these two sentences, following one close upon the other might lead an unsophisticated investor to suppose that the mine had been recently proved to contain quartz of an average value of 16½ dwts. per ton. The sworn returns from this property since January 1st, 1888, published in the Government blue books, show an average of only $4\frac{7}{10}$ dwts. per ton, from nearly 5,000 tons crushed. The cost of extracting and milling the ore, *including dead work*, is put at about 6 dwts. Was there any margin for profit on these 5,000 tons?

The prospectus also says that the "excellent plant of modern machinery," now on the property was "erected at a cost of over £16,000;" that "over £30,000 has been already expended in opening up the property, and in erecting buildings, purchasing machinery, etc., etc." Also that "the directors have secured as manager, the present lessee, Mr. Alonzo A. Hayward, who has the advantage of knowing the property thoroughly, having as lessee carried on the work profitably for several years past," and that he has "agreed to devote his entire time to the management at the mine, receiving only the nominal amount of £15 per month," etc., etc.

One can imagine an inquisitive shareholder asking these questions: "How is it that this excellent plant of modern machinery cost £16,000 stg. when it is assessed on the tax books of the Province at only £1,600 or thereabouts? Why should it have cost £16,000 stg. if it is worth only £1,600 or 10 per cent.?

This inquisitive shareholder might also have a taste for calculations, and, fortified by the Government returns might say: "The total number of days labor returned upon this property since this American company began work under Mr. Hayward, is about 15,000; assuming the average price of labor per day to be $1.50 (which is above the average rate for Nova Scotia) $22,500 will be required for the labor bill; the ratio of fuel, power, explosives and supplies to labor in Nova Scotia appears to be under 50 per cent., but assuming it to be 50 per cent. we must add $11,250 to the above, making a total of $33,750, or say broadly £7,000 stg. This will leave the *cost price* of your plant *less labor on same*, some £23,000. Now your prospectus says £16,000, and the taxed value is £1,600. Is it wise to select for the future management of this syndicate a gentleman who has needed so much money to erect a plant assessed at so low a valuation? or are your figures wrong? If so what do you mean by publishing them in a document for which you are liable?"

The directors may also have this question asked them, "You state that Mr. Hayward 'as lessee carried on the work profitably with little or no capital for *several years past.*' Can you give to shareholders any statement of the margin of profit per ton obtained by Mr. Hayward on the 8 or 9 dwt. quartz mined by him during the 10 or 12 *months* of his lease in 1891 and 1892?"

The directors would be less liable if the word "*years*" was changed to "*months*." The prospectus says "It is estimated that the ore won in the exploratory work will in any event more than pay expenses incurred" in such work. The Government returns show that the ore won in the exploratory work done by the former manager in the years 1888 to 1891 inclusive, was 3,041$\frac{8}{10}$ tons, yielding 349½ ozs. of gold, an average value per ton of 2⅓ dwts. Does this syndicate really believe that 2⅓ dwts. of gold per ton "will more than pay" the expenses of driving cross-cuts and levels through the hard country rock of Waverley district? If so they disagree with the estimate of their own engineers who have put it at at least $3.00.

The prospectus also says that the "statements and estimates are made upon the authority of information furnished by the vendor and Messrs. Bainbridge, Seymour & Co., who have favorably reported on the property." The inquisitive shareholder again comes to the front and says to these gentlemen, "Your report is dated 6th January, 1893, and as all work ceased on the property in April, 1892, it is presumable that you would have all data of production at hand before you made this report. Have you, or any of your subordinates, visited this mine since December, 1891? Because your report says that from January 1st, 1888, to January 1st, 1893, the production has been 2,197 tons, yielding 911 ounces. Now the sworn returns made to the Mines Office between the above dates show 4,927 tons yielding 1,166 (and a fraction) ounces. Up to the 1st of December, 1891, some 2,076 tons had been milled by the Lake View Co., but only *237* ounces were returned. You make 674 ozs. more than the sworn returns show. Will Messrs. Bainbridge, Seymour and Co. kindly explain from whence those 674 ozs. came; or what particular 2,197 tons gave 911 ozs?"

A pertinent question is, what evidence have the directors to show that the average yield of the past five years ($4\frac{7}{10}$ dwts.) is going to at once increase to the 15 dwts. upon which is based their calculation of dividends?

The gold mines of Nova Scotia are good investments when properties are selected with care and managed with ability and economy, and they need, as a rule, large working capital. But British investors are asked (not only with regard to this scheme but all others as well) to look carefully into the alleged merits of the enterprise and also into the character of the management proposed.

EN PASSANT.

In the compilation on the subject of the Industrial uses of mica presented by the editor of this paper before the General Mining Association of the Province of Quebec last month it was stated that the new insulator known to electricians as Micanite was made from pulverized or comminuted mica mixed with liquid cement. In a letter from the Mica Insulator Company of New York, the writer describes this new insulator as follows :—

"We take natural sheet mica, small pieces preferred, from which we manufacture Micanite. We have nothing to do with ground mica, nor do we use it in any form. We are able under our patented process to take small pieces of waste mica, and build it up into sheets 40 inches square, and larger if necessary ; and we are also able to make it in any desired form. We are supplying the electrical trade very largely, in fact we have more orders than we can fill. We wish to compliment you, however, on your article, as it is certainly very interesting. We send you by mail a sample slot trough made for the W. P. 50 Armature Thomson-Houston motor. By examining this, you will see at a glance that we do not use ground mica as any one would suppose we do from reading your article." It gives us great pleasure to acknowledge and give space to this correction.

They who are ever looking for the American capitalist whose arrival will develop our iron mines, and who believe he is sure to come because President Cleveland will take the duty off iron ore, may be able to reconcile their hopes with the facts that hundreds of iron miners have been paid off in the Lake Superior districts, several mines have been shut down, and ore has been offered cheaper than ever before known in the history of American iron mines.

The market for Canadian Asbestos, at last advices, is reported more hopeful and several contracts at fair prices, have been made. An English correspondent states that stocks on hand are greatly reduced but that buyers are holding off in the hope of getting a further drop in prices.

With the closing down of the High Rock and Squaw Hill Mines active operations in the production of apatite in the Ottawa Valley ceases and the industry for the first time in its history is at a complete standstill. Our last quotation for 80 per cent. is 10½ d. Hamburg, a slight advance which we trust will be the precursor of better things.

Another new device for the prevention of cage accidents has been invented. This time the patentee is Mr. T Settle, manager of the New Mill Gas Works, Huddersfield, England. According to the description supplied by Mr. Settle, a chain or rope is attached to the cage in the ordinary way, but on the top of the cage, on either side of the chain, is a hinged vertical link, on the upper end of which is a horizontal lever, the opposite end being hinged to a block capable of sliding up and down vertical rods placed at each side of the cage for that purpose. The vertical links and horizontal levers are so arranged that when the cage is suspended by the chain the blocks move more freely up and down the vertical rods ; but if the chain or rope break and cease to suspend the cage then the ends of the horizontal levers come into contact with a stud and bind against the vertical rods, whereby the descent of the cage is at once arrested. This takes place whether the rope or chain is lowering or lifting the cage. Guide rods of 1½ inches in diameter, it is stated, will bear a breaking strain of 78 tons considerably in excess of the weight and load of an ordinary cage, which usually ranges from five to fifteen tons.

Accounts come from Germany that Herr Krupp is now constructing a number of experimental engines to test a novel idea. A German inventor has taken out letters patent covering the utilization of the general principal that finely divided carbonaceous matter floating in the air readily explodes. He proposes to grind coal to an impalpable powder, and, after introducing the dust floating in the air into the cylinder of an engine, explode it, the idea being to follow very much the same lines which are being so thoroughly developed in the use of gas in engine practice. Naturally, the first question which has arisen has been how to get rid of the ash. Herr Krupp is reported to have stated that his experience in gun manufacture convinces him that this is not a serious obstacle. The advantages which would grow out of a direct utilization of mineral fuel as mined are very obvious. While modern practice converts only 10 to 15 per cent. of the heat energy stored in coal into power at the crank shaft of a steam engine, it is believed that no less than 75 to 80 per cent. could be made available by the direct combustion of the fuel through explosion of coal dust.

Professor A. B. W. Kennedy, F.R.S., delivered a lecture in the Royal Institution, London, Eng., recently on "Possible and Impossible Economies in Energy Utilization," a subject which he described as of national interest, as economy in energy might mean wealth and prosperity to a nation, while waste in energy might mean diminished commerce and general depression. As an engineer, he stood on the firm basis of the fact that nothing was impossible except perpetual motion and the transmutation of metals. In essence, all the imposibilities he would have to mention were perpetual motions—attempts to get more out of something than was in it. He gave as instances the attempts to utilize the steam in an engine over and over again, and to make out of coal a fuel which had twice the value of the coal itself. More than half the possibilities of economy were possibilities of improving up to the best work already done. If, for instance, the average working of steam boilers all over this country were brought up to the standard of the best working, about 30 per cent. of our coal would be saved. He analysed the working of electric light plant, compressed air plant, and electric tramway plant, as well as steam and gas engines, and said there was no very large possibility in saving in the generation of electricity, but there was an enormous possibility of economy in utilizing the current for light in the lamp itself. He also emphasised the importance of superheating steam. To sum up, there seemed to be no very startling possibilities before us, except in increasing the efficiency of electric lamps and bringing up gas engines to their theoretical maximum. In other respects matters would develope more or less rapidly, but always less and less rapidly as they approach the limit of efficiency.

The Council of the Mining Society of Nova Scotia is arranging an excellent programme for the Quarterly General Meeting to be held on 27th and 28th of June, at New Glasgow. The works of the Pictou Charcoal Iron Co., the New Glasgow Coal, Iron and Rail Co., and the Nova Scotia Steel Works, together with an inspection of the collieries in the neighborhood are features which in themselves should stimulate a large attendance.

The General Mining Association of Quebec will hold its next meeting at Sherbrooke on Wednesday, 5th July. An excursion on Lake Memphremagog to the charming watering place at Newport, together with other items of unusual attractiveness are on the cards. Mr. F. P. Buck, a prominent citizen of Sherbrooke, and a member of Council, has the programme in hand which is a sufficient guarantee of the excellence of the bill of fare to be provided. At the sessions several papers on subjects of interest will be submitted.

In a discussion on the subject of mis-shots before the Manchester Geological Society a Mr. Dobbs said that at his colliery they had fired some 16,000 shots during the year, and 23 had missed. These detonators were recovered by boring a hole 9 in. to 12 in. from the old hole and charging it, then connecting the wires of the mis-shot to the cable, so that when the mis-shot was fired there was no difficulty in finding the mis-detonator. His instructions were strict on this point; the mis-detonator must be found. When recovered they were brought to his office and the cause of the mis-shot ascertained. In eight cases out of 23 he had found it to be the fault of the detonator wires being broken, and in the 15 he could not fire them with the battery. Another speaker claimed that the occurrence of missed shots can be

largely prevented by the action of managers in insisting that the shot-lighters should test the exploders and cables at least once a week, the exploders to be tested on a volt-meter to see if the proper number of volts are registered (at least 65 volts.) and the cables tested to see that the wires are not damaged by being broken or short circuited in any way. It is advisable in choosing exploders that those having a large reserve of power should be selected. Instruments are now made registering 120 volts, and only weigh a few pounds.

It would seem that the miners of the Province of Quebec are not alone in their grievance on subject of explosives for we find on reading Lord Randolph Churchill's interesting book "Men Mines and Animals in South Africa," that at Johannesburg, dynamite, an article of prime necessity in a mining country has been made the subject of a monopoly, and granted by the Government of the Transvaal to an individual who, for considerations unknown, is entitled to exclude all other dynamite from the country but his own, and receives a royalty of 12s. 6d. a ton on all his own dynamite which is consumed.

Mr. Isaiah Johnson (Manchester Geological Society) claimed for the steel or iron girder as a substitute for timber in mines the following advantages :—First, That its life is at least six times that of timber. Second, That there is a proportionately less risk. Third, No stoppages through falls. Fourth, That when a roof is done with, the materials can be used again, or, even if they had to be sold, they would at least take scrap price, whereas timber when broken would be worthless. Therefore taking into consideration the use of labor, and the danger of taking out old timber and refixing new, which is very costly apart from risk, he was convinced that the use of steel and iron for the securing of main roads is preferable to timber.

The revenue derived by the Department of Interior from the sales of coal lands in the North-West Territory during the year ended 31st October, 1892, was $3,374.70, being an increase of $1,093.70 over the preceding year. The total area of coal lands sold up to date is 13,649.86 acres, and the total amount received therefor $141,083.27.

In our issue of March we published an interesting contribution to the Transactions of the American Institute of Mining Engineers from the pen of Mr. E. E. Russell Tratman, New York on the subject of unfreezable dynamite. In a recent note to the Institute Mr. Tratman called attention to a new high explosive called Maximite, which has been brought out in the United States and is claimed to be both unfreezable and smokeless. It is a nitro-compound, with gun-cotton for its base, and is the invention of Mr. Hudson Maxim, who has had considerable success with the manufacture of smokeless rifle-powders from nitro-compounds. He is now erecting a plant for the manufacture of the new explosive on a commercial scale. Maximite is said to be equal in power (weight for weight) to pure nitro-glycerine and nitro-gelatine, while 10 ounces of it are equal to 1 pound of 90 per cent. dynamite. The cartridges are fired by ordinary exploders, and cannot be exploded by striking. The products of combustion are mainly carbonic acid gas and water.

As to Liebert's unfreezable dynamite, Mr. Tratman has not yet been able to obtain from the owner of the American patent any particulars of the extent of its manufacture and use abroad, but it is said that arrangements are being made for its manufacture on a large scale in England. A company was organized in London for this purpose in 1890, but apparently nothing practical has yet been done. Col. Majendie, R.E., Chief Inspector of Explosives for the British Government, writes that no explosive of that name, and none claiming to possess its non-freezing property, has been placed on the official list of authorized explosives. A dynamite (Von Dahmen's) which was claimed to possess this property was submitted to the Department of Explosives in 1889. Upon due examination it was approved, but no examinations were made as to its alleged non-freezing property. No license to manufacture or import this dynamite was ever secured, and it is therefore not on the official list.

In a recent number of the Transactions of the Manchester Geological Society, Mr. Jas. Grundy, one of H. M. Inspectors of Mines in Great Britain has something of interest to say on the subject of barometric observations in connection with colliery working. He suggests that one of the practical steps to find out the real value of the barometer as an indicator of dangers to be avoided would be for a number of persons intimately connected with collieries to keep records of a self-recording barometer of a good make, and at the same time arrange for the many and varied changes that take place in mines being as far as possible noted and compared with barometric readings. The observations and records would include falls of roof and sides, unusual appearance of fire-damp or black damp. They would also be of great service in the solution of the problem as to what extent the weighting and unexpected falls of roof, sides, or coal, as well as the issue of gas from them, and from the coal, are affected by the atmospheric pressure. Another matter worth investigation, is the changes, if any in the generality of air circulating in the mine ; or the relative value of the air for ventilating, during the varying atmospheric pressures.

Notwithstanding the dullness that is prevalent in certain branches of our mining industries it is gratifying to find that our manufacturers of mining machinery have their hands more than full. The Ingersoll Rock Drill Co., is working night and day shifts, and the same activity is noticeable at the works of the Canadian Rand Drill Co. and the Jenckes Machine Co. at Sherbrooke. The Ingersoll people have orders in hand for two 20 x 24 piston inlet compressors, and 22 Sergeant coal mining machines, eight boilers and other plant for the new Dominion Coal Company, besides compressors and mining plant for the Lake Gerard Mica Mining System and other mines. The Jenckes Machine Co's large and well equipped establishment at Sherbrooke is also busy on plant for the Dominion Coal Co., among which we noticed the other day two large hoisting engines. Other manufacturers in Ontario and Nova Scotia, we are glad to see, are also doing good business with our mines and quarries.

At a meeting of sub-committee of the General Mining Association of the province of Quebec, held at Sherbrooke, Que., on 12th instant, it was resolved to recommend that the Association memorialise the Government to extend the working of the present law respecting the free admission of mining machinery to read "That all machinery and appliances for mining, quarrying, smelting, concentrating, refining and treating ores or minerals not manufactured in Canada be admitted free of duty." As our readers are aware the law at present is restricted to *mining* machinery only. Needless to say such a change in the application of the tariff is a consummation most devoutly to be wished by every mineral operator in the country. At the same meeting a statement of the various classes and kinds of mining machinery manufactured in Canada was drawn up. This has been forwarded to the Mining Society of Nova Scotia for extension and revision and will be finally submitted for adoption at the meeting of the Association at Sherbrooke on 5th July. It will then be fyled with the Department of Customs for reference.

Under date of 15th instant the North Sydney *Herald* contains the following :—

"Can you give an anxious public any information as to what has become of the threatened legal proceedings against the Ottawa Mining Journal by Mr. Kennelly? It will be remembered that this periodical over six months ago gave some enlightening information of certain management of the property of the Sydney & Louisburg Coal & Railway Company's property in Cape Breton. The uninitiated and unsuspecting stood aghast at the fearlessness, certainly begotten of an honesty of purpose, that characterized the utterances of the Mining Journal in its criticisms of the management of that unfortunate company's property. After the appearance of those articles Mr. Kennelly threatened the Mining Journal with legal annihilation unless it would withdraw its statements. The Journal refused to move one iota from its position or withdraw one word of its published statement and dared Mr. Kennelly to legal combat. Has the ex-manager of the Sydney & Louisburg company considered discretion the better part of valor and withdrawn the libel suit against the Mining Journal? Possibly dreams of that famous "impact of running ice" has cooled down his wrath. It would be funny to hear his narrative, under cross-examination in a court of law, of the origin, growth, capital, disposition of profits, management and personnel of a mercantile firm in this town called 'J. Webb & Co.' The Journal, in its scathing review, referred to this concern. Does the ex-manager remember this? Although his career in Cape Breton is ended, and although everyone laughs at him and at the many, in a certain sense, amusing tales told of a management, the success of which I will allow sore-hearted stockholders to tell, yet I, like the rest of a curious and amused public, would like to know what has become of Kennelly's famous libel suit against the Ottawa Mining Journal?"

So would we!

MINING NOTES.

Nova Scotia.

Beaver Dam.

It is reported, on good authority, that this district will be worked again this summer; satisfactory arrangements having been made with the concern formerly operating here.

Darr's Hill.

Quartz from the Dufferin mine is reported to be rising in grade. The vein found in the north crosscut is being worked, and shows a higher grade of ore than in the old vein. Miners are reported scarce.

Killag.

From the manager of the Old Provincial Co., it is learned that the level driven this winter on the Stuart lode has shown up a large body of pay quartz. Rumor says some of the reserves are high grade rock. Cross-cuts from the first level are now driving north and south to cut other veins lying parallel with the Stuart lode. Only a small force employed.

Fifteen Mile Stream.

Arrangements for the operation of the properties recently consolidated here, are reported completed, and it is expected that the district will produce largely this summer. Mr. James A. Fraser is in charge of the work.

Gay's River.

The mammoth mill erected here two years ago, has been sold to the corporation owning (and about to operate) the Memramcook, N.B. conglomerate. Rumor says the price paid for 50 stamp mill complete (engines, boilers, etc.) with the store, dwelling houses, and other buildings was $5000.00. The Memramcook Co. got a bargain, but we advise them to go slow on their mine.

Country Harbor.

The Antigonish Co. are remodelling their mill and hoisting outfit. The Truro Foundry Co. has the job of supplying and erecting most of the machinery. This company, under the conservative management of Mr. J. C. MacDonald, has already won an enviable record, and when the changes contemplated are finished will have much enlarged their capacity and output. The yield from Stormont district this year, is likely to lead all other districts.

Stormont.

The Richardson mine continues its regular yield of about ½ oz. per ton, producing a monthly output of 150 to 180 ozs. Five additional stamps are being added to the fifteen head already in, and will be dropping in June. This mine and the Antigonish mine at Country Harbor, appear to have reserves ahead for a steadily prosperous year in 1893.

Negotiations are on foot looking to the re-opening of some of the old properties in the east side of Isaacs Harbor. This side has been idle for several years, but owing to causes other than lack of paying veins. The whole east side should be consolidated and put under one management, in which case large and steady returns would follow.

Waverley.

The West Waverley Co's mill of ten stamps, crushed during March, 651 tons in 24½ full working days. This is believed to be the best record yet made in Canada for a ten stamp mill. The company are now adding ten more stamps making a total of twenty, and expect to have the new stamps dropping in June. The Truro Foundry Co. is suppling the iron work for the new plant.

Oldham.

This district, for the first few months of the present year, is beating previous record. Something over 1100 ozs. is reported to May 1st.

Quartz is now being mined by the Standard Co., (Taylor & Hardman) from a depth of 500 feet, yielding from 5 to 10 ozs. to the ton. A new straight line Rand Compressor has just replaced a smaller machine, and work this summer will be vigorously pushed.

The Napier Mining Co., will start to sink a new lift in the vertical shaft June 1st.

The Columbia Mining & Milling Co., returns 58 ozs. from 225 tons crushed, to April 1st. All work by this company is now on contract.

Montagu.

The Nova Scotia Mines Ltd., under the able management of W. R. Thomas are opening up a large body of reserves, whilst steadily increasing their output. This mine has been seriously handicapped by the reckless operations carried on under previous managements, and the London Company is to be congratulated in having at last got the right man at the Nova Scotia end.

Quebec.

Eastern Townships.

The Eustis, Nicholas, and Howard pyrites mines are reported to be working full time.

With the opening of summer the asbestos mines at Black Lake and Thetford show increased activity, but the general demand for the product has been so limited that the operations are confined to a few companies.

At Thetford the Bell's Asbestos Co. has a large force at work, principally producing lower grades (No. 2 and 3), there being evidently enough of "firsts" on hand to supply all demands.

Messrs. King Bros. who have operated their mill during the winter on lower grades have resumed mining with about twenty men.

The Johnson's Company has not yet attempted any mining this year, but a few men are kept on mill work.

The Beaver Asbestos Co. is working a fair force, but of course, greatly reduced in comparison with former years.

The American Asbestos Co., after being closed down for two years, has resumed work with a large force under Superintendent Klein.

The only other property at Black Lake on which mining is being done is that of the Anglo-Canadian Asbestos Company, and here too, as at Thetford the number of men employed is comparatively small.

The other companies it is understood will raise but little if any asbestos this season, the general desire being to wait for an improved market and work off stock at present on hand.

The annual general meeting of the members of the Asbestos Club has been called for the 25th inst., but at date of writing we have not heard the result of the meeting. Dull times at the mines and unfortunate differences among the executive have of late rather demoralized this useful institution. The REVIEW in common with all visitors to the asbestos region, has a very lively recollection of many pleasant and instructive gatherings and of hospitality served with a generous hand in the comfortable club house. We sincerely hope matters may be so adjusted that the club will resume its sphere of usefulness. The club is altogether too important an institution to be allowed to drop.

Extensive improvements at the Lake Gerard mica mine are contemplated this summer. A larger compressor (Ingersoll) and other plant will be put in. The output continues about 20 tons weekly.

Work on the Hall white mica mine at Escoumains, below Quebec, has been resumed this month. The mine was opened up in November and shut down toward the end of January. Ten men were employed. During that time 3,700 lbs. of cut mica of an average value of $1.50 per lb., was taken out. This mica was taken from a shaft about 15 feet wide, 10 feet long and 25 feet deep. The vein of spar and quartz now being worked runs from 50 to 60 feet in width and about 1,700 feet long. The mica is of excellent quality and gives an average size of 4 x 4. It is beyond a doubt the richest deposit of white mica ever discovered in Canada. The property is owned by Messrs. G. B. Hall, Daniel McGir and John C. Eno, all of Quebec.

Ontario.

North Burgess.

The Lake Girard Mica System's mine at North Burgess has produced about 50 tons monthly since January last.

Mr. T. W. H. Leavitt, of Detroit, has opened up a fine amber mica property in North Burgess. Ten men are employed and some 1,500 tons taken out in a few weeks work.

Lake of the Woods.

The Sultana gold mine is now employing 32 men, about half in the mine and half in the mill. The mill has a 10-stamp battery with an amalgamating plant, and is crushing some 20 tons of ore per day. The concentrates are shipped. The new development recently has consisted in opening up a new lode which is said to be about 12 ft. in width, averaging from 1 to 3 oz.

At the Tremaine the shaft is down about 100 ft. and a considerable quantity of ore has been taken out, most of which is free milling gold ore. A reduction plant is soon to be put up, it is said.

British Columbia.

Mr. Geo. McCabe of Kaslo, was in Ottawa a few days ago and returned to the coast with a bond of Mr. John Askwith's gold property in the McMurdo district, the "Bobbie Burns." The property was bonded for some American investors at a figure in the vicinity of $25,000.

The Kootenay and Columbia Prospecting and Mining Co. of Ottawa shipped a car of mining machinery to the "Wellington" near Kaslo, B.C. last week. The outfit consisted of Kelly sectional boiler, Ingersoll drill, Blake pump, steam hoist, ore buckets, tools, steel, etc. Shipment was routed over the Canadian Pacific, via Revelstoke and the C. & K. Navigation Co. to Kaslo. The rate of freight averaged $2.75 for 100 lbs.

This company had a working bond on the "Wellington" and closed for purchase on May 1st. Development work will be pushed and arrangements made for freighting ore out in June. About 60 tons high grade ore varying from 240 to 1000 ozs. silver are now on the dump ready for packing.

Says the *Nelson Tribune*:—"The boys who make their headquarters at Ainsworth have lost more sleep locating claims after midnight than those of any other camp in Kootenay. A claim, believed to be of value, was relocatable at midnight of the 12th inst, and two parties started to relocate it. One party was made up of well known prospectors like Alex. McLeod, Henry Cody, and George Whitten; the other was headed by George W. Adrain. Both knew the ground well in daylight, but neither party knew the lay of the land after dark. For a while the hills around the Patah claim looked as if a hundred jack-o'-lanterns had suddenly sprung up. One party had no end of mishaps in the dark before they got the claim staked, and the other had no end of misfortunes in daylight before he left the inside of the recorder's office. The Adrian party knew nothing of the other party, and the other party knew all about what Mr. Adrian was sitting on the steps of the record office for so early on the morning of the 13th. Promptly at 10 o'clock the record office was opened, and while Mr. Adrian was placing a Winchester rifle, with which he was armed, in a place of safety, the other boys stepped in and handed the recorder their location notice for the mineral claim "Nightshift" When Mr. Adrian handed his location notice in he was informed that he was too late. Mr. Adrian is now in doubt whether to use the Winchester on the mining recorder or on the boys who got ahead of him, and the mining recorder wishes the "Nightshift" had never been located."

Says the *Golden Era*:—"We hear that there is every probability of the Golden smelter being in active and continuous operation this year. The information is based on the knowledge that arrangements for a supply of ore are complete."

Writing under date 5th instant, the Kaslo-Slocan correspondent of the *North-West Mining Review* says:

The snow is fast disappearing here and the indications are that before the month of June the prospectors and miners now lying idle here will all be busy in the hills. There has been no ore shipped from the mines for the last few days and it is doubtful if there will be any for some time to come as the road is almost impassible and threatens to become worse. However there still remains hundreds of tons stored away in Hughes' warehouse awaiting shipment.

All speculation regarding the merits of this district has been removed by last winter's showings and it must now be conceded that the Kaslo-Slocan is among the richest ore producing countries in the world. It was generally believed when first discovered that there might be a few mines in this locality, but as development work goes on it brings to light the fact that not one or two of the prospects, but all of them which have been worked are Simon pure mines whose average production will exceed $165 per ton in value and in quantity seems illimitable. The veins which have been worked all winter and prove themselves worthy of trust are the Bluebird, Washington, Freddy Lee, Mountain Chief, Chambers Group, Idaho, Wonderful, Slocan, Boy, Reco, Fremont, The Best, Queen Bess, Dardanelles, A. D., (formerly Big Bertha), Slocan Star, Grady group, Jackson, Noble 5, Alamo, Lucky Jim, Payne group and Northern Belle.

All of these have opened up in splendid fashion, some exceeding the most sanguine expectations of their owners or bonders. The Washington, Idaho, Freddy Lee and Grady group have been shipping ore all winter and have more ready for shipment. The A. D. people lost the ore chute recently but are now drifting and expect to tap it again shortly.

All the way between here and the Duncan river the shores are lined with the camps of prospectors who are working up that way.

Reports from the Duncan and Lardeau state that those rivers are rising rapidly and all desirous of reaching those sections had better start in now.

Rumour has it that they have struck a very rich body in the Chambers. This group is going to make John M. Burke, the fortunate bond holder, a very wealthy man.

Reports of new strikes are coming in every day but with few exceptions it is impossible to verttfy them; several have been made in the immediate vicinity of this city.

The Occurrence and Reduction of Gold.*

By Alfred Woodhouse, F.G.S., Mem. Inst. Mining and Metallurgy.

In this paper I propose to deal with points of interest that have struck me in the gold fields of India, Africa and Nova Scotia, and as my acquaintance with the latter is very short, I put forward my views with considerable diffidence, trusting that other members with far greater experience of this Province, will not hesitate to criticize and explain the errors I fall into, for in my opinion, it is the discussion and not the paper that educates.

The subject gold has a fascination for every one and though termed the "root of all evil," is decidedly a blessing to civilization when properly employed. Gold is, I believe, the only metal for which a market is always ready, and it is the standard by which all products are valued.

Although gold occurs usually in very small quantities compared with other metals, it is probably one of the most widely distributed, as traces of gold are found almost everywhere, but not often in paying quantities.

Experience in different countries has shown that the profitable working of gold *does not necessarily follow* the existence of the metal in payable quantities, and I propose to point out in this paper some of the causes of failure.

Gold occurs in three forms as follows:—

1. In veins of quartz or other hard substance embedded in the matrix.

2. Associated with sulphurets of iron, copper, lead, etc., either chemically combined or otherwise.

3. In alluvial; that is in the detritus formed by the erosion of auriferous rocks due to action of weather, sun and atmosphere, by which particles of gold have been liberated, the lighter grains of ground or powdered rock have been carried away, leaving the heavier mineral near the orignal source. I do not propose entertaining the disputed question of nuggets.

These three occurrences of gold are too extensive to be dealt with in one paper, and I will therefore confine myself to the first, or the occurrence in quartz and other hard silicious matrix.

Although one continually hears that gold occurs in some particular district, in quite a different way than in other countries, experience tends to show that, *practically the same laws of nature* govern all districts in different parts of the world, and I have found practical knowledge in any one country proves invaluable in new fields.

The miner however, must expect to find *local characteristics* and probably no two districts have the same, but if parallel veins of quartz occuring in identically the same formation and lying only a few feet apart, differ so entirely not only in yield of gold, but actually in the nature of matrix, one may reasonably expect very great differences in two districts thousands of miles apart. To sum up I wish to convey the probability that gold occurs in veins of quartz in all countries, following certain laws of nature, affected by certain local characteristics, and that the difference in yield of two parallel veins in similar formation tends to show that our knowledge of the origin of gold is very limited.

A visitor to Nova Scotia hears a great deal about the anticlinal (or anticline) angulars, etc., but does the anticline affect the richness of the ore or do the veins nearest this point prove richer than those farther away? I think we must look further for a cause of rich streaks or deposits.

"Angulars" is a good local name for the numerous veins, strings or droppers of quartz that fall into and in some cases cross the true or formation veins or leads. These small angulars are not confined to Nova Scotia but are generally found in all countries under the name of feeders, which have leeched the country rock of mineral matter and fed them to the mother or formation veins.

All angulars however do not bring in a deposit of gold, and therefore certain angulars must have special advantages, if these are *really* the only source for introduction of gold, which theory I cannot agree with. Owing to the entire absence of a system of cross cutting in settled ground below, little is known of parallel veins except from surface indications, which are usually most deceptive, but I think it probable that many of these angulars are merely strings of quartz connecting two parallel veins. Angulars do not always terminate on contact with formation veins but pass through and continue on the opposite side, or they continue parallel with the vein for several feet and then cross over; in these cases they should, I think, be called "cross courses," and these cross courses *do* in my opinion play a very considerable part in the occurrence of gold. I have found by experience the nearer the cross course approaches to a parallel with the true vein the richer the deposit of mineral matter.

In the Montagu district the gold "chutes or streaks" usually occur from 200 to 250 feet apart and dip to the west at an angle of 43° to 45° and the irregularity indicates that the the "chutes" owe their origin to something more than angulars or cross courses.

If it is acknowledged that the precipitation of gold and metals is causcd by certain laws of nature, and not by chance, we have reason to expect that the same laws have placed the gold in Nova Scotia mines that have occasioned the deposits in other countries.

The following will illustrate one theory of how gold may have been deposited in "chutes" or "streaks":—

All will admit that originally the formation of slate and quartzite was in a horizontal position, as it was deposited under water probably containing mineral matter in solution, now it follows that this mineral matter would be precipitated provided certain foreign elements were introduced, say for instance, some vegetable matter.

No doubt everyone has seen the peculiar streaks or lines of seaweed on the ocean carried in comparatively parallel lines by currents, the water between these lines of seaweed being entirely clear of foreign substance. Precipitation of mineral matter will be far greater on the line of seaweed or foreign substance than in the clear water. This illustration merely shows the possible theory of gold deposits in streaks by vegetable or other matter carried in parallel lines by currents over the newly deposited muds since converted into slates and quartzites.

Interesting as any theory of formation may be, I propose confining myself to the practical and profitable side of gold mining, that is following and extracting to the greatest advantage this valuable metal.

In commencing mining operations the engineer's first work is to very thoroughly inspect his ground, locating as far as possible his different leads and learning where gold has been found by former owners, making careful notes of past results. From his notes he will be able to make a rough plan and form some idea where gold may be expected below. With this knowledge he locates the position of his first attack, by adit if possible, if not by main shaft, selecting a position as convenient as possible to the mill site, which should be chosen well above the flat ground, so that no trouble will occur in the future from tailings. As the main workings and mill site form the centre of all future operations, too much care cannot be given to the selection of a place which offers the greatest facilities for permanent works. Managers often forget to look ahead to the future, when the mine requirements may assume very great proportions and instead of adding to the original works, a *fresh start* has to be made on a more suitable site.

The works should be laid out *originally* with a view to future contingencies, and the plan of operations carried out by degrees as funds will permit. Above all things the reckless cutting up of the surface by what are termed trial shafts should be avoided, as these become reservoirs to catch water and flood the future workings, necessitating afterwards costly pumping machinery, for once the mischevious work is done, it can never be undone.

Having located the main shaft, the manager should decide to sink certain depth, say 120 feet for his first level, and steadily continue to this depth, no matter what rich rock is met, the gold will not run away, and can be far more cheapl yraised by overhand stoping from below, than from the system of burrowing or underhand stoping so common in the province.

I very strongly advise following the value of the rock passed through by saving "the drillings," the miners being supplied with marked tins for this purpose. It should be the foreman's business to see that these are delivered regularly to the manager who should pan them off and enter results in a book kept for that purpose. Many rich deposits have been found by this method when the gold was too finely distributed to be visible and and would possibly otherwise have been overlooked.

As a rule the gold, or rather the payable portion of the lead, will be found to occur principally in chutes or streaks, the quartz rock between two streaks proving unpayable, and yet too often this unprofitable rock is taken out and crushed not only with a loss on the work, but also on the wear and tear of the machinery.

It is true every mine cannot maintain an assay department, but the manager can always follow his ore with the pan, and I am surprised to see the pan so seldom used in Nova Scotia knowing from experience its great value as a guide.

The question of vertical or inclined shafts is one that is attracting attention; the inclined shaft, for prospecting work, has the advantage that the lead is tested as sunk upon, but any fault, slide, or change in dip of the vein at once causes trouble, and with the numerous quartz leads found in most districts of Nova Scotia which must be cross cut afterwards, I consider vertical shafts the most desirable for permanent works, as it is only the one vein and that at one point which can be tested by the incline following the lead. When the vertical shaft has been sunk to a level it is easy to raise up or sink a winze on the vein in order that stoping can be commenced.

Working capital is provided to carry out the dead work which opens a mine, that is, sinking shaft and drifting on the various leads and further, when the mine is proved, to provide for the purchase and erection of the necessary machinery. When this has been accomplished, the cost of developing fresh ground to replace that extracted, should be added to cost of breaking and crushing a ton of ore.

With the shaft down to first level, the pan should prove the value of rock passed through, and the result should be carefully noted on the large working plan of the mine so that the position of the gold streaks on the next level may be fairly located. My experience has shown, that once the rule of the occurrence of the gold is determined, nature is wonderfully true to herself, and unless from some fault or intrusion the gold will be found where looked for. If more careful attention was given to this matter much useless work need not be attempted.

In some mines of the Province, notably Montagu, "nuggets" so called are found within the line of the streak or chute, and often contain from two hundred to three hundred ounces of gold in a few hundredweight of quartz. These nuggets occur with some regularity 10 or 12 feet apart, and naturally greatly increase the yield, but as it has been the custom in the past to crush all ore throughout the mine, the average value of the rich chute has been much reduced by the addition of the unprofitable rock between the streaks, worth possibly only two or three dwts. per ton; and as there would be fully ten times as much of this poor rock crushed as of the streak ore, the rich ore has had to pay the loss on treating an increased tonnage, which must return a lower yield per ton throughout.

When the developments of Montagu enable the manager to attack only the streaks, leaving the poorer rock 'in situ' the returns should greatly exceed those made in the past, especially as by that time more of the occurrence of the gold will have been learned by experience under systematic workings.

The mines I have seen in the Province, appear unusually free of water, except such as is derived from surface, where the numerous pits and cuttings form attractive reservoirs, and I have reason to think that if the shafts were puddled with clay well tamped behind the lagging, very little water would be found below.

Considering the minute proportion of gold to the bulk of rock, too much care cannot be given to avoiding unnecessary handling of the ore, from which there must be loss in gold and increased expense. The rock as broken should fall into passes connecting with the level, whence a truck after being filled carries it to the shaft, and is hoisted to surface on the cage and delivered by tramway to the mill-house. When tipped, the ore is shot through a grizzly into the ore bins which supply the self-feeders, the large lumps which fail to pass through being put into the stonebreaker. By this method, handling of quartz is reduced to a minimum.

Too ofen the first object of a manager is to make a good show on the surface, and he starts erecting substantial works before he has learnt the value of the mine. This is surely putting the cart before the horse, for surface works do not pay dividends and it is far wiser to expend working capital first in development to prove what the mine contains, merely erecting such plant as is absolutely necessary for the requirements of development; before launching out into handsome buildings and expensive machinery, a system which has brought many a good mine into liquidation.

Ample working capital is most essential, and I do not consider Nova Scotian mines as a rule have had a fair chance in that respect. What would have been accomplished in other countries if they had had only the few hundred pounds that this Province has had? Failure would have been anticipated and I consider very great credit is due to the mining men here that they have done so much with the small means at their command.

Again, owing to the fact that many of the mines have been opened by men having small capital, the profits have been distributed without building up a reserve fund for developing new ground when the rich ore they worked yielded smaller returns, and in consequence many mines that have yielded handsome profits in the past, are now closed down from want of funds to open out rich ore lying below. With ample working capital mines can be worked not only on a larger scale, but by drawing ore from a dozen different points, the temporary falling off in yield at one or two places would not materially affect the return.

With the experience of the Indian Mines, having a working capital of at least $100,000, and those of the Transvaal where half a million dollars is far from an uncommon working capital for machinery and mine development, the small system of working in this Province, cannot be considered a fair comparison and yet I am convinced, from my own personal experience, that Nova Scotian mines will amply repay the outlay of large capital, provided it is judiciously expended, I mean in *bona fide* development, and not for show on surface.

The quartz occurs principally as bedded veins in a country formation of talcose or argillaceous slate, and dense quartzite tilted almost on edge, and the leads are likely to continue gold bearing to great depth, in fact, as deep as the slates. It is, however, probable that the sulphurets will increase as greater depth is reached. And as considerable gold is associated with these sulphurets of iron, copper, arsenic, lead and zinc, more attention should be given to their concentration and treatment, and generally they will be fonnd a welcome asset.

The ore having been delivered at the mill the next process is, to extract the gold as effectually as possible, and I would impress upon mining men that amalgamation is a science, and that it does not mean feeding so much rock under stampers with the addition of water to splash out the crushed particles, which are then conducted over some amalgamated copper plates. Any school boy or ignorant man can do that and catch a certain percentage of the gold.

The science of amalgamation is arresting and separating the last particle of gold that can profitably be extracted from the quartz rock, and I mean by this, that there is a point of gold saving, beyond which it costs more to extract the extra percentage than the value of the gold recovered

The two first objects are to get the particles of crushed rock out of the mortar box, when reduced sufficiently to pass the screens, without unnecessary pounding; and secondly to retain the gold in or as near the box as possible, and with this idea an amalgamated plate is generally placed inside the mortar box. On the crushed ore or pulp leaving the box, the great object is to check the forward flow of pulp as much as possible without causing it to silt, the tendency of a check being to precipitate any particles of gold either floating on the water or held in suspension, on to the amalgamated copper plate.

* Paper presented at the last meeting of the Mining Society of Nova Scotia.

The advantages and disadvantages of introducing quicksilver into the mortar boxes, are much disputed, but I have found that with most ores it answers well provided a copper plate is securely fixed at the back in a recess cast for the purpose, but in case of introduction, it should be used cautiously, otherwise it will be floured and splashed out on to the plates and a good deal will pass away into the tailings, as it is found floured quicksilver will not readily remain on the copper plate.

In case of grease and oil getting into the box with the quartz, it is advisable to introduce common caustic soda every few hours, as this dissolves the grease and keeps the inside sweet.

For ordinary quartz, I find a drop 8-9 inches 80 to 85 times a minute most effective, and with coarse gold a steel wire screen with 1,000 holes per square inch. In some ores however, the gold is so finely disseminated, that 2,000 holes is not too fine, but the capacity of the mill is naturally reduced with the smaller mesh.

In the Montagu mill the pulp as splashed through the screens falls on a plate 10 inches wide inclined towards the battery, with a pitch of 1 in 10 or 12, and is thus directed over a series of two ripples of quicksilver, with a third one below empty, so as to catch any quicksilver washed over, and thus protect the plate which should be 4 feet long with two ripples below, the upper one only being filled with quicksilver. From here the pulp passes over a second plate 4 feet long and then is conducted to the concentrator.

Although there are numerous patents for concentrators they are mostly very expensive, and often decidedly complicated, and I find the old fashioned straight throw Australian percussion table answers very well and has the great advantage of cheap construction by the mine carpenter.

This concentrator consists of a solidly built wooden table some eight feet long with two divisions. The first with a copper plate set at a low angle say 45 degrees eighteen inches long, from which with a rise of 1½ inches in 2 ft. 6 in. is built the floor up which the ore must ascend. The lower half of the table is similar. This table is hung by four strong iron arms and is held firmly against a bumping block by a powerful spring. With a treble cam the table is pushed forward about one inch to be pressed back by the spring when free of cam, from 180 to 240 times a minute.

The jar naturally settles the heavy pyrites, the lighter sand passing off with the water. Any straying particles of gold or amalgam are caught on the copper plate, while floured quicksilver is again united by the continuous action. The machine is capable of taking five to seven tons every 24 hours. The concentrates are removed with a small shovel by the amalgamator when necessary.

A frequent loss of gold occurs from using too much water over the tables, there should only be just enough to make the black sand and pyrites drag along without actually silting.

Plates should be dressed every four hours, and at that time the battery and water should be stopped, as a piece of amalgam once moved is liable to be swept away with a rush of water. In dressing the plates, a very weak solution of cyanide of potassium may be used to remove any oxide of copper, but on no account should a plate be touched by the naked hand, a piece of chamois leather should always be used.

The quicksilver in the ripples should be retorted once a month as retorted quicksilver has a greater affinity for the fine particles of gold than that which is charged and the gold produced from retorting well repays the cost and trouble.

The use of sodium amalgam and cyanide is not to be encouraged, as both are very dangerous to the plates, and quicksilver, unless thoroughly understood, but a very small piece of sodium amalgam, say the size of a pea, may be placed in each ripple once or twice a week to liven up the quicksilver.

Samples of tailings should be drawn every hour, water and all, and allowed to settle, and fire assays should determine the daily loss of gold per ton.

All details of mill work, such as stoppages, length and cause, time quicksilver introduced to mortars, speed of stamps, delivery of ore, etc., should be regularly entered in the mill book, which should be signed at end of shift by amalgamator. If these details are necessary, in an ordinary office, surely they should be attended to when a valuable mineral like gold is concerned.

It is not possible to enter into the question of the various chemical processes for treatment of concentrates in this paper, but I have found very effective results from simply grinding them to a fine slime, more especially if they have been spread out on floors, and exposed to the action of the sun and weather for several months. If a little salt is added, and the material kept constantly moist and turned over once a week, decomposition is rapidly effected and a very considerable proportion of the gold is liberated on treatment, and is rapidly amalgamated by quicksilver.

In grinding, I have found it advisable to add very little water for some time, so that the quicksilver may permeate the very thick mud in minute globules (which however are not in the form of floured mercury) and to assist the process, I usually add a little salt, caustic soda and cyanide, and after grinding for three or four hours a stream of water is turned on and carries off the slime to a percussion table, where pyrites not sufficiently ground are retained. The quicksilver remains in the grinding pan, which after the water is syphoned off, is ready for a fresh charge of concentrates say 5 or 10 cwt.

My object in dwelling on the concentrator and grinding process for treatment, lies in the fact that both can be carried out on most of the mines in the province at low cost and are fairly effective, but should practical bulk treatment prove the sulphurets to have the value I believe they have it will then be time for the manager to look about for a more effective and modern process.

The President then called for discussion on the paper, printed copies of which the members had received previously.

MR. HARDMAN—I am going to say a few words about Mr. Woodhouse's paper. The main thing I wish to say is that he does not give us a chance to attack him. He has dealt largely with generalities in which we all agree. But there is one point in connection with the illustration given of "How gold may have been deposited in chutes or streaks" to which I may draw attention. I do not think Mr. Woodhouse has elaborated this illustration so much as he might have done.

The existence of gold in the seawater of the present time in amounts equivalent (according to Sonstadt) to nearly 1 grain, or 4 cents per ton justifies the assumption that the ancient seawaters were equally auriferous and very possibly more so. From these mineral bearing waters the slates and quartzites in their deposition as muds or sands may have precipitated or taken down with them more or less gold. And I may say here that a rough calculation will show that the gold contained in the present oceans is sufficient to account for more than all the gold that has ever been extracted from the earth's crust so far as we have any records in history. If then we use Mr. Woodhouse's illustration of parallel lines of seaweed, or organic debris, we have *a* theory of the deposition of gold in streaks; assuming that organic matter has been a good and sufficient reagent for the deposition of metallic gold from dilute solutions, the deposition will have been greatest, as a matter of course, along the lines where this organic matter was accumulated.

Perhaps you are all familiar with the beautiful experiments of Mr. Chas. Wilkinson and Mr. Daintree of the Victorian Geological Survey, which have shown so conclusively the way in which gold can be precipitated in metallic form, even from very dilute solutions, by organic matter. In a paper written by Mr. Chas. Wilkinson in 1866 these experiments are given in detail, and he mentions an accidental experiment of Mr. Daintree's which led to the experiments undertaken later by himself. Mr. Daintree even in those early days, was an amateur photographer; on one occasion he had prepared for photographic use a solution of chloride of gold, the ordinary terchloride, leaving in it a small piece of metallic gold undissolved. Accidentally a piece of the cork, with which the bottle was stoppered fell into the solution, decomposing it, and causing ths gold to precipitate around the small piece of undissolved metal, increasing it to two or three times its original size. Previous to this however, Dr. Selwyn, who at that time was director of the Victoria Geological Survery, had in one of his reports suggested as a possible reason for larger nuggets being found in the drifts or gravels than in the quartz reefs, that gold might have existed in solution in the mineral waters permeating the Silurian drifts or gold gravels of Victoria, and that this mineral water in so percolating might have been in some way decomposed and have precipitated its gold contents around the most congenial nuclei presented to it, which, electro-chemically speaking, would be the particles of reef gold already existing in the gravels.

Mr. Wilkinson, having knowledge of Mr. Daintree's accidental experiment, and of Dr. Selwyn's suggestion, was led to make some experiments. Briefly stated, the results were confirmatory, and established that metallic gold was easily and rapidly (in from 3 days to 3 weeks time) precipitated from dilute solutions of the chloride salt by the agency of organic matter, which, in order to imitate nature's processes as closely as possible, usually consisted of a chip of wood. In these experiments Mr. Wilkinson used as neuclei particles of iron and copper pyrites, galena, zinc blende, antimony and other metallic minerals, and he found also that weak solutions gave better results than strong ones. But I am taking up too much time, and will say little more, except that to those interested in the matter the experiments of Newberry with mine timbers taken from Sandhurst, Ballarat and Scarsdale will prove instructive. In every case gold was found in the timber assayed. I might also refer to Dr. Holland's article in the "Geology of Vermont" and to the well known fact that sulphuretted hydrogen is evolved from the decomposition of marine vegetable matter. All I have said has been meant to follow out the idea in this paper of Mr. Woodhouse's, an idea which is well worth keeping in mind as bearing on the possible origin of "Streaks and Chutes."—I think his illustration of the precipitation of gold along the lines of seaweed, formed by wave action is very apposite. I would like however to ask Mr. Woodhouse to define what he means by "Formation Veins," and also to give us his reasons for the statement made on page 7 of the printed copy of his paper that "*It is, however, probable that the sulphurets will increase as greater depth is reached.*" We are seekers after information, and any knowedge as to *why* we may expect an increase of gold or of sulphurets with increased depths will, I am sure, be very acceptable and pleasing to all of us who are mining for metals.

MR. WOODHOUSE—I am very much obliged to Mr. Hardman for the criticisms and remarks he has made. Perhaps the paper is rather more general than it should be. By "formation veins" I mean veins running with the formation, what are called here "main" or "regular" lodes. In regard to the statement that gold may have been precipitated from sea water—while there is no doubt about one grain of gold being contained in every ton of sea water, yet it is a very vexed question how it may be thrown down from its solution. I have heard some professors on different occasions give their views, and very rarely have any two agreed. As regards the sulphurets being found in increased quantity at increased depths—the tendency would be to get them below the water level at greater depths, because below the water level the deposit of metallic sulphurets is going on at the present time. I do not mean to convey in this paper the idea that sulphurets will persistently increase the farther down you go. At a certain point you will find a considerable change, which point varies in different mines, and is usually the water level.

MR. HARDMAN—May I ask what you have found to be the permanent water level in this country?

MR. WOODHOUSE—Say you go down a couple of hundred feet.

MR. HARDMAN—I have been down 500 feet and have not struck subterranean water.

CAPT. GEO. MACDUFF—As far as my experience has gone we have no water level in the gold-fields here; it is all surface water that we contend with. I may mention that at our mines in Waverley we built dams in the 200 level which caught all our water, and it was surface water; below that level we only had two or three casks of water per day.

MR. HAYWARD—Leaving the question of water-level and returning to Mr. Woodhouse's statement as to sulphurets, if the veins when formed were in an approximately vertical position there might be something in Mr. Woodhouse's claim, but if in a horizontal position I fail to see it.

THE PRESIDENT—Some years ago I interested myself a little in the matter about the formation of our gold lodes, and the presence of gold in streaks and in so-called nuggets. I have got out of the business of late, and it comes to me like a very vague recollection. I have just turned up what I had written some years ago in reference to cross leads or cross-courses, and their apparent effect on certain of the many formations, and I may just quote:* "Mining operations are not confined to the bedded leads, for rich streaks of paying quartz have been followed in cross leads and in what are called "angling" leads. As a rule cross leads of later age than the true leads are barren, or contain but a few pennyweights of gold. Their influence, or that rather of some so-called cross leads, on the productiveness of a regular lead is often remarked on, but cross courses of later date are not always distinguished from contemporaneous connecting bands of quartz filling transverse fractures of the same age as the bedded leads. The effect of cross leads on the productiveness of regular leads is worthy of note. For instance, at the junction of a cross lead with the belt lead at Montagu, some rich spots gave as high as 40 ounces to the ton. Then in the discovery lead at Uniacke the quartz was found to be richer near the junction of what is there called a cross lead, but which in reality is an off-shoot from the lead into the hanging wall, the quartz of both being homogeneous. * * * Whether the yield of the bedded leads is in reality influenced by the position of the cross leads may be doubted, and so of off-shots, for in many leads the number is great and a rich streak has many chances of being near one. It does not appear, however, to be a rule that the dip of the streak and the off-shoot is in the same direction. No cross lead is known to shift a bedded lead, though faults and breaks are numerous."

These are some of the conclusions I came to:

Regarding the divisibility of gold and its universal dissemination, although we regard gold as one of the most stable of substances—it is interesting to note an incident at the Mint in Philadelphia. After pulling off the roof of the old Mint building it was sold for $4000, and it realized to the purchaser a greater value.

Regarding the formation of gold or nuggets in gravel deposits I have in my possession a small piece of gold about one-half an inch in diameter from the lower carboniferous conglomerate of Gays River, which has a perfectly smooth surface with rounded edges, and it is water worn. It must have been formed prior to the conglomerate for on its flat surfaces rest groups of sharp edged particles; evidently they are subsequent attachments, *i.e.* subsequent to the deposition of the conglomerate.

CAPT. MACDUFF—Speaking of "cross-courses," the term does not seem to be understood here in Nova Scotia. In Australia we always find the richest gold near the disturbances. I have not, in my experience in Nova Scotia, met with a true cross-course excepting the one at Waverley in the workings of the Lake View Company, but that has not seemed to have effect upon the veins. I have however met many times with breaks, slides, slips, &c., shifting the vein for a few feet. Where you have a cross-course it is usually filled up with broken foreign matter, and it heaves the vein many feet.

MR. REID—I would refer Capt. MacDuff to the lake lode at Caribou.

CAPT. MACDUFF—I have been there and examined the lode; that is not a cross-course but a shift or heave of the lode.

MR. WILLIS—I may mention two cross courses met with at Rawden, one, from two to fourteen feet in width filled with broken fragments of slate quartz and quartzite, which cuts the old Northup mine vein; and a second one 1,500 feet east and parallel with the first one. This second one is now being tested by the Central Rawden Co.

* Report of the Dept. of Mines, N.S., for the year 1878, pp. 22, 23.

Notes on some Special Features in Lode Formation and Deposition of Gold, as Presented in the Waverley Gold District, Halifax Co., Nova Scotia. *

By B. C. Wilson, Waverley, N.S.

I do not know that a knowledge of the origin of gold would be of any practical value or add anything to the sum of human happiness, but the method of its deposition and its geological associations are of economic importance as affording inferential authority as to the best means of extracting it from the place "where they find it," as Solomon expressed it.

This question when applied to Nova Scotia deposits is usually answered upon the generally accepted theory that most of our auriferous quartz veins, now found at all angles, from horizontal to vertical, were originally beds of silicious matter impregnated or charged with the constituents of the several minerals now found imbedded in them with intervening beds of slate or other rock, and built up in alternating layers much as the Coal Measures are, only differing in composition and presumably in age, and that apparently through the shrinking of the earth's mass and the forces of gravity calling on the outer crust to "close up" towards the centre, which crust, from its acquired rigidity, in consequence of exposure to external influences, could not follow in unbroken order it had to obey the inexorable mandate by reducing its surface area through a series of synclinal and anticlinal folds. Of the former, we, from obvious reasons, see fewer examples than of the more exposed anticlinal exhibits.

Every gold district has certain features in common with all the rest and each has other features distinctively individual, which, if thoroughly studied out, afford authority for local development, and I purpose to give you some account of these features generally and individually, as presented in the Waverley gold field.

This district is located twelve miles from the City of Halifax, and was among the very first half dozen discovered in the Province, and has the distinction of having had the very first licensed quartz mill in the country as appears on the records in the Mines Office at Halifax.

The auriferous veins of this district are on an anticlinal with an exposure of about two miles in a general east and west direction conforming in this respect with the general trend of upheavals over the Province. A very pronounced fault or break occurs near the middle of the district locally causing the distinctions East and West Waverley, and crosses the strata or line of upheaval at nearly right angles, that is, north and south, forming the depression occupied by the chain of lakes and stream utilized years ago by the "Shubenacadie canal." This fault is the most important one of the district, and so far it has not been possible to locate any vein found on one side as a continuation of any vein on the other. Another fault occurs on the west division which follows a surface depression along the line dividing areas 174 and 175, but the displacement is not important and the respective veins have been located on each side of it.

The anticlinal is most pronounced on the western division, the upheaval having been greatest there, and exposing more of the auriferous lodes, which stand nearly vertical in the middle of the district and assume gradually greater depression as they reach towards the western curvature. The extreme western exposure presents the continuation of the same veins round from the north dip to the southern dip, as notably exhibited in the workings on the Tudor vein between 1862 and 1869.

It is a noticeable feature of the district that while we have two western curvatures and dips of the veins, as yet we cannot place our hands on any indication of an eastern curvature or dip, nothing in fact to determine the termination of the lodes easterly.

The two western curvatures or depressions are represented: first, by the one on West Waverley including such veins as Dominion, Tudor, Taylor, No. 6, &c., some of which have been traced to and into the canal lakes before referred to and under which the main fault occurs. Beyond this commence the lodes of East Waverley (east of the fault) and they too present a west curvature and dip towards the same lakes, and extend away east indefinitely, their eastern curvature and dip not being yet demonstrated, a piece of swampy ground operating against surface exploration.

I do not consider it at all proven that the two formations are identical, or rendered only apparently independent through influences of the great fault nor that they represent separate or independent anticlinals. This must be left for future developments to determine.

The ores of the district are recognized as free milling, with limited quantities of sulphurets, the gold being present in fine grains through the quartz, with occasional quantities of considerable value as instanced in a lot of about 500 ounces taken from about 1,000 pounds of quartz from the Barrel lode on East Waverley in 1862.

The Taylor and Tudor lodes were early representative lodes on the west division of the district. The first gold found on the Taylor was a nugget of 6 to 8 ounces, the ore being quartz with but very little associated minerals. The Tudor was an exceptionally well defined vein from 10 to 30 inches thick with smooth walls, and though no large nuggets were found, small ones from 5 to 20 dwt. were frequent. This lode was for a long time the chief gold producer of the district, the monthly brick from it at times being from 1,000 to 1,200 ounces.

* Paper read before last meeting of the Mining Society of Nova Scotia.

Formerly no account was taken of the sulphurets in the ore nor of the gold they carried, but latterly more attention has been directed towards them. By far the greater proportion of sulphurets in the Waverley ores is arsenical iron, of which one distinctive feature is noticeable, (and I am not aware whether it prevails in other districts or not,) which is, that where the arsenical iron is imbedded in the body of the quartz it is usually rich in gold, but where it is situated as a slab or deposit on one side of a lode, that is mixed up with the slate and quartz on one side of the vein only, it rarely carries much gold, assaying but from 10 to 25 dollars per ton of concentrates.

Some thirty years ago a vein two or three inches thick was opened near the centre of the district on West Waverley which was practically solid arsenical iron but as it showed little or no visible gold it was ignored, for no one at that time thought of an assay test. Also about the same time a vein 4 to 6 inches thick was opened on the extreme western curvature which was probably 75 to 90 per cent. sulphurets, chiefly arsenical iron but associated with copper, and though presenting but very little free gold yielded under the stamps from 10 to 21 dwts. per ton, but the vein being narrow and the density of the ore making it objectionable for crushing, it was not worked beyond a few tons and no assay test of its value was ever made, but from my recollections of it I have every confidence it was a valuable ore, and if it maintains its size will yet pay to work.

The Barrel lode on East Waverley carries arsenical iron distributed in small quantities through the quartz and frequently in pockets from a pound to a hundred pounds, and occasionally in lots of a ton or thereabouts, quite crowding out the quartz or more properly taking the place of the quartz in the vein, and such deposits were invariably rich in gold, but at the time they were worked, twenty-five to thirty years ago, their value was not recognized, but I have knowledge of a lot of four or five tons collected by natural concentration as it ran from the mill and taken up after a year's exposure to the elements and put through the stamps again which yielded 63 dwts. of gold for the lot.

The workings on the western division have reached nearly 400 feet in depth, and have developed no special feature beyond a well defined formation, the veins on both the north and south dips maintaining their full strength and showing no signs of extinction.

One important feature demonstrated in this district is that comparatively no flow of water worth mentioning has been found in the deep workings. What has to be contended with is from surface sources largely increased in the old workings by the ill advised methods of mining twenty-five years ago where the drainage has been *into* instead of *from* the mines, but this can be avoided in the future by making new openings and operating under the old works which in general have no considerable depth.

During the first 14 years that the Waverley mines were operated some 51,000 ounces of gold were reported at the mines office, fully eight tenths of which were obtained from West Waverley, since which time until the last two or three years all mining there was relegated to the spasmodic and destructive operations of tributers.

The ore on the east division though discovered simultaneously with that on the west and at that time considered the richest in gold was supposed to be circumscribed in area and local conditions prevented any extensive operations. Yet it is on this east division where the most interesting geological problems are presented, and where glacial and pre-glacial forces have left their unmistakable imprint.

The ground to the west of the main fault before referred to extends away in low hillocks seldom reaching over 90 feet above the level of the lakes.

On the east side the exposed rock rises abruptly from the lake in a strong mountain range, backed by an extended table-land and attaining an altitude of about 200 feet in places, and this heavy deposit of metamorphic rock appears to have been an occupant in possession long anterior to the anticlinal upheaval, which brought the auriferous lodes of the Waverley district to the surface, and further, this back bone of table rock appears to have presented decided objections to being disturbed by the ambitious new comer, and if the two powers of the period exchanged any courtesies they were probably akin to those between the ant and the elephant "Who are you shoving," at any rate there are evidences of some very decided "shoving" on the part of the latest arrival and some equally obstinate resistance by the original "party in possession" and so vigorous was this conflict that the old mountain carries very conspicuous marks of it on his back, and had grudgingly to afford room for the obtrusive metaliferous series, but still held its own so well that there are no scars on its western brow, and it had such a firm foothold under the waters of the lake below that there are no signs of his having "budged an inch."

In 1862 some drift quartz carrying gold was found on the top of this hill, and further search revealed the outcrop of a sheet of quartz lying nearly horizontal, covered with two to four feet of soil and a corresponding amount of rock, and continued workings disclosed what might aptly be termed a blanket of quartz overlying the hill and gradually dipping south, west and north, but most decidedly to the west, or towards the lake at the foot of the hill, and several small owners soon made numerous openings on it, each apparently intent on forming open reservoirs for the local water-shed and in which they were exceptionally successful, and discounting the future for immediate results, soon got it in such condition that no one could work it, notwithstanding the ore at one time was very remunerative; and eventually all work ceased except an occasional effort of some tributor, who managed to find some spot of ore on high ground. But practically everything was under water and it became generally conceded that the only economic means of operating it would be through a tunnel driven from the lake level and intercepting the vein at about 200 to 250 feet below the surface openings and thus escape the overwhelming water of the surface. The scheme though a good one was confronted with the necessity of providing many thousand dollars to carry it out, also a further deterrent was the frequently expressed doubt of the vein existing at that depth and in such position as to be reached as proposed. But after a lapse of many years such a tunnel was eventually driven some 635 feet, and last December struck the vein on the back or crown of the anticlinal on its western dip toward and presumably under the lake where as before mentioned the old mountain has such a firm foothold.

The developments from both tunnel and surface workings are most interesting to the geologist as well as to the miner, a very interesting feature being the peculiar forms presented by the auriferous vein.

At the outcrop it was crimped or folded together upon itself and if smoothed out like a sheet of paper would have presented a vein not over 10 to 12 inches thick, but being folded together it filled a space of 20 to 30 inches, and with associated slate occupied a working belt of about 48 inches between the upper and lower enclosing walls of hard metamorphic rock, and when denuded of the overlying rock presented the appearance of rows of barrels and hence the name "Barrel Lode" was applied.

There was originally much speculation as to what would be the form of the vein at the tunnel level. Some thought it possible that it would be smoothed out, that is, divested of its crimpings which were presumed to be the result of surface shrinkage or compression. On the contrary the foldings as demonstrated in the tunnel workings are in no way changed beyond being apparently compacted by the increased weight of the superincumbent rock.

Whatever may have been the difference in age or time of deposition of the several strata and auriferous veins the condition in which we find the quartz may be accepted as presumptive evidence that at the time of upheaval, the material composing the several belts must have been in different states of rigidity as the quartzite under the Barrel Lode shows only occasional change of form, consequently must have been quite rigid while the overlying rock was most pliable and conformed in some measure to the forces exerted upon it, but the auriferous belt, particularly the quartz part of it (and now the most rigid of all) and which plainly shows the marks of laminated deposition must have been the most plastic of the lot, to admit of its carrying all its laminations unbroken through all its various bendings and curvatures, and there are instances where the quartz is found forced into wedged-shaped cracks or cavities in the rock ending in rounded edges and leaving an unfilled space at the extreme end of the split, much the form that soft putty would assume if pressed into a similar cavity and apparently demonstrating that the infilling material was not silicious waters eventually solidified as in the case of fissure veins.

So far as present workings demonstrate, at the lower or tunnel level, which I estimate will vary at different points from 250 to 500 feet below the surface openings (not in perpendicular height, but on the dip of the vein) there is nothing to warrant the belief that the character or value of the ore is in any degree changed or that it is richer or poorer than was the 6000 tons (or thereabouts) mined at the outcrop, nothing in fact to throw any light upon the probabilities of deep mining in the Province beyond what we already know.

The ore is identical in color, markings and associated minerals and the gold is deposited in the matrix with the same idiosyncracy which characterized it at the surface, and so far as can be predicted, short of milling test, in about the same relative proportions.

Reviewing the foregoing from an economic or miner's standpoint I may observe that the conformation of our Province affords but few places where this method of reaching the ore through a tunnel giving drainage and exit for ore without pumping or hoisting, will apply.

The rock throughout the gold series of Nova Scotia is generally compact and after the first fifty or seventy-five feet there is very little 'coming' or bottom water to contend with. The greatest trouble being from surface sources aggravated by the pernicious system of mining heretofore pursued and perpetuated in many cases to the present day of artificially carrying the natural drainage into instead of away from the mine and ensuring to the persevering miner a supply of water sufficient to keep him poor and busy all his lifetime in keeping it out. If however the surface accumulations from whatever cause or source can be gathered and carried off by gravity, then further and deeper workings, though below Atlantic or other drainage level, can be conducted with such an immunity from this indispensable element in the wrong place, that it becomes a consideration if it is not economy to incur the initial outlay for drainage large though it be, where conditions make it practicable.

Returning to geological considerations again. There was one interesting feature presented on the Barrel Lode which it has never been my privilege to witness elsewhere, viz.: glacial markings on quartz.

When in the surface workings, the soil was removed from the rock overlying the quartz at or near the outcrop, the striae or glacial footprints were such as to rejoice the heart of an enthusiastic geologist, and in fact many are yet visible on portions of the undisturbed rock. In one spot where the auriferous vein protruded through its metamorphic covering a strip of quartz probably 25 feet

long by 8 or 10 feet wide had been exposed to glacial scouring, the inequalities worn down, and the quartz polished like a piece of ivory, and eroded creases half an inch deep, cut into the retaining rock on either side, were continued straight on across this polished quartz showing the continuous striae or track of nature's great planing mill.

The fact of the quartz being so doubled up with the slate within the walls of the working belt, and that the underlying quartzite shows hardly any evidence of lateral compression, and the overlying only to a limited extent and only in the vicinity of a contact with the quartz, we are led to enquire what was the relative consistency of the several masses and whence came the apparent excess of vein matter to admit of so much folding. It would seem as if the piston of some mighty cosmic engine had been exerting special pressure upon the auriferous belt from some unknown distance, utilizing the upper and lower walls as a cylinder, and if so one might expect to find evidence of a movement of the material composing the working belt (slate and quartz) within the limits of its 'foot' and 'hanging walls,' and this is just what we do find evidence of in the polished state of the relative surfaces as though there had been a sliding of the auriferous belt within the stationary retaining walls.

Now whether this was just what did occur I am unable to state, I am merely giving you the facts as we find them illustrated in the workings and if we accept the inference as stated it would seem to demand that the auriferous vein as originally deposited must have occupied less space than now, say about 12 inches of quartz and 12 inches of slate —laying out smooth—not crimped, and contemporaneously with the upheaval, lateral pressure was exerted on the vein matter which forced the upper and lower retaining walls apart, permitting the quartz and slate to fold up and occupy about four feet between foot and hanging walls, but just how the great natural engine applied its force or whence it got the extra supply of auriferous vein matter are questions to which I offer no solution.

THE PRESIDENT—The second paragraph of Mr. Wilson's paper attracts my attention. I will only take one point. The good that a man does is always accepted —it is only his weaknesses that we want to discuss, and therefore if I hold a view differing from Mr. Wilson it does not follow that I am objecting to the rest of the paper. The drawings which Mr. Wilson has prepared showing the actual position of these barrels is an interesting sketch. Mr. Wilson says :—

"This question when applied to Nova Scotia deposits is usually answered upon the generally accepted theory that most of our auriferous quartz veins, now found at all angles from horizontal to vertical, were originally beds of silicious matter impregnated or charged with the constituents of the several minerals now found imbedded in them with intervening beds of slate or other rock, and built up in alternating layers much as the Coal Measures are, only differing in composition and presumably in age."

I think I know something about coal measures. The auriferous quartz veins or lodes were not deposited in the same way. Mr. Wilson has a very good authority for the views which he takes. Dr. Hunt, whose chemical geology is a standard work even to-day, visited the Province about the year 1870 and wrote a report. I ventured in 1878 to take issue with him upon the conclusions which he drew—and then I wrote as follows :—*

"The distinctive features of the gold leads of Nova Scotia are their general conformability with the slate and quartzite beds and their regularity, suggesting that they are rather beds than veins. But there are characters that point to their being true veins in spite of these features, and they are the following. The roughness of the planes of contact between quartz, slate and quartzite ; the crushed state of the slate or gangue on some foot-walls ; the irregularity of their mineral contents ; the terminations of the leads ; the effects of contemporary dislocations ; and the influence of stringers and offshoots on the richness of the leads, characters that singly or collectively it would be difficult to account for, associated with a stratified deposit."

I venture to think that my opportunities of going underground which I had enjoyed some years before were greater than Dr. Hunt's, and having this statement in view I was continually looking at the face of the slopes to see if his conclusions were justified by the appearance of the quartzites, etc., and I came to the reverse conclusion. I saw nothing there that would lead me to believe that they were truly bedded deposits. The quartz in all cases appeared to me to be of subsequent deposition. That it contained fragments of slate lying in all conceivable positions in relation to the beds of quartzite—that fragments tailed off from the lead that appeared falling out and held partially away from the walls—just as you find them in drift veins which cross the regular leads contrary to the bedding. The only thing that made me at all doubtful was the invariable appearance of these leads lying between beds of slate and quartzite. If you carefully observed you would see that the lode did vary in a bed of slate sometimes from one side to the other. Between two beds of quartzite which govern the character of the formation, you had always slate on one side and partially on the other. I came to the conclusion that it was quartz which had been subsequently deposited. Of course these cracks occurred from the folding of the strata in the regular form which we now have it, and that is a point. Mr. Faribault has been mapping these veins with a great deal of care showing the whole series from one end of the Province to the other. His report will be to the effect that the folding is due to subsequent pressure and that the pressure that has been brought to bear by lateral pressure was caused hy the continuous accumulation of depositions in deep seas which lie against or along the straight edge of older rocks—such as has since formed the range of the Appelachian chain which extended in this direction. I think this question is an interesting one and one open to great elaboration.

MR. HARDMAN.—I also wish to differ from Mr. Wilson in respect to his view that our gold veins were once horizontal beds, contemporaneous with the slate and quartzite. Mr. Wilson makes one or two statements rather in the line of questions, inviting comparison with other districts—one is in relation to the value of the sulphurets when found in different positions in the vein-stone. He says, "he is not aware whether it prevails in other districts or not, that where the arsenical iron is imbedded in the body of the quartz it is usually rich in gold, but that where it is situated as a slab or deposit one side of a lode (that is mixed up with the slate and quartz on one side of the vein only) it rarely carries much gold."

Our experience at Oldham, where the sulphurets occur on one side—the hanging wall side—is that they will average in value $75 to the ton ; where they occur in the middle of the vein the assay yields $12 to the ton.

In the Dominion lode I am working at Waverley, I find a great divergence in the sulphurets, whether taken from the middle or side of the vein. One or two samples that have been taken from the foot wall side of the vein have shown values approaching $30 which is more than treble the value of those samples taken from the middle of the vein.

At Isaac's Harbor, on the Victoria lode, I noted also that the sulphurets nearest the slate wall were richer than those in the body of the vein. I may say that the slate in Oldham is on the hanging wall of the lode, and the sulphurets that are rich lie next the slate.

As to another point Mr. Wilson does not consider the two formations of Waverley identical—*i.e.* East Waverley and West Waverley. I would like to ask him whether he means to say that East and West Waverley were not contemporaneous—that they were not produced simultaneously by the same pressure which produced the anticlinal. If he does then he differs from Professor Hind. It seems to me also that he is going back of the record of the different lodes. I cannot avoid the conclusion that they were both contemporaneous. He also says that the fault on the western side is not important.

From a mercenary point of view I am extremely interested in this fault, and think it the most important of them all.

MR. WILSON—In reference to that fault Mr. Hardman refers I suppose to the fault between areas No. 174 and No. 175, which I believe is somewhere about 118 feet in extent. I look upon that as not a shifting of the material of the ground north and south, but I look upon it as a direct movement up and down of the material composing the rock on what is called the "American Hill," and you will understand if a vein or portion of ground lying at that angle is broken off, and lifted square up, that the other vein down here will be represented over here a number of feet to the north, on account of that dip being to the north. I have always considered that the fault referred to was not a lateral break of the ground, by which a portion of the ground was carried north or south, but rather a direct raising up of the material forming "American Hill."

MR. HARDMAN—In order to be a direct raising up the angle of that fault plane would have to be a ninety degree dip. The dip of that fault is to the eastward, therefore it could not have been a direct lifting up—there must have been a sliding action.

MR. WILSON—We must take a great deal of our our geology upon faith. I find a great many questions arising in the Waverley formation which are quite enigmas to me, and I cannot see that anybody else has been able to explain them. Our worthy president's father did undertake to explain to me the origin of the quartz at Laidlaw's Hill, but I do not know that his statements have been borne out by developments afterwards, nor that they have been very far astray either. There are certain points we have not got around yet, and I have been careful not to advance any of these as my own theory, nor would I back them up, still in the absence of anything better, I will have to adopt them.

I made the statements regarding sulphurets on my experience. I always considered where gold showed in the sulphurets, those sulphurets were richer than those which showed no gold. Sulphurets which are associated with gold in the quartz are invariably pretty rich.

MR. HARDMAN—I sent some nodules of arsenical pyrites to be assayed which were in the midst of white quartz, and which carried large gold particles, yet they gave only six pennyweights to the ton of arsenical iron.

MR. HAYWARD—Was that from the Dominion lode?

MR. HARDMAN—Yes.

MR. HAYWARD—As to East and West Waverley, and referring to the breaks, it has always been my opinion that American Hill has been shifted to the north 118 feet, and also that it has been raised up 80 feet, from its original position.

In forming these conclusions I found the formation of the rock east of the break, as it was broken, tailed to the south, and that the fault was traceable through the valley.

MR. STUART—I have nothing to say with regard to Waverley, Mr. President, but I agree with your own remarks and Mr. Hardman's in regard to this auriferous formation not carrying bedded leads. Every day I see evidence of that negative fact ; and there is no stronger evidence that I have ever seen than the lake lead at Caribou, which is in a bed of talcose slate. This section I have made (and will hand around) represents 150 feet in length of the lode and if you will notice where the lode crosses the strata you will find it is much richer than where it runs parallel with the strata. I am now speaking of the lake lode vein proper. Where the rich quartz occurred in the lake lode mine, running back across the strata, there were no feeders.

Where we got the very rich quartz which I took out last December on the Truro Company's property, there were feeders, that is, the rich quartz was in one of those side leads which divide the vein. I cannot see how it is possible that our auriferous leads in Nova Scotia have ever been formed in any other position than that in which they are found to-day.

* Report of Dept. of Mines, N.S., for the year 1878, p. 27.

Mineral Wealth of British Columbia.*

BY GEORGE DAWSON, C.M.G., LL.D., F.R.S. OTTAWA.

Had I known in time that it would be my privilege to address the Fellows of the Royal Colonial Institute on the subject of the "Mineral Wealth of British Columbia," I should have taken pains to provide myself with specimens of the ores, and with photographs and maps suitable for illustration. Without these means of enforcing and explaining my remarks, I feel that my endeavor is undertaken at some disadvantages, and this especially because I wish to speak of a country of which the mining importance lies chiefly in its future, and for which, though some substantial progress has already been made, it is not yet possible to refer to the statistics of great mining enterprises.

As it is, I am indebted to the Royal Geographical Society for the use of the map exhibited, upon which I must rely in order to convey some definite ideas on the subject in hand.

For fifteen years or more I have been engaged in the exploration and geological examination of British Columbia in connection with the Geological Survey of Canada, and have thus enjoyed the opportunity of traversing and inspecting a large part of this province of Canada. The information gained has been embodied in a series of official reports, published from year to year, and it is only because it may be assumed that such reports are seldom read that I can venture to hope that what I have to say may possess some interest or novelty at the present time.

British Columbia is the western province of the Dominion of Canada, with a coast-line of over 500 miles in length, from south to north, on the Pacific. It is the largest of the Canadian provinces which has yet been defined, and may be described as possessing truly imperial dimensions. Its length of coast (without counting its extraordinary sinuosities) is nearly equal to the combined length of England and Scotland ; while its area of 383,300 square miles is over three time that of the United Kingdom, and greater than that of any country in Europe except Russia.

It is in the main a land of mountains, including nearly 1,000 miles in length of that broken western margin of the American Continent, which, in lieu of any better name, is known as the Rocky Mountain region or Cordilleran Belt. Although it possesses valuable fisheries and remarkable resources in its forests, besides important tracts of arable and pasture land, much of its prosperity must depend on the development of its mineral wealth, which is the compensation afforded by nature for the generally rugged character of a large part of its surface.

Less than one hundred years ago, the region now named British Columbia was wholly unknown. At about that time its coast began to be explored in some detail by Cook, Vancouver, and other navigators, and soon after, this coast became the resort of a certain number of trading vessels in search of furs ; but none of these adventurers acquired any knowledge of the interior of the country. Almost simultaneously, however, the explorers and traders of the North-West and Hudson's Bay Companies, pushing on and extending their operations from point to point in the interior of the North American Continent, began to enter the hitherto mysterious region of the Rocky Mountain from its inland side. Mackenzie was the first to reach the Pacific, and following him came Fraser, Thompson, Campbell and others, all Scotchmen in the service of these trading companies, till by degrees several trading posts were established, and "New Caledonia," as the whole region was then named, came to be recognized as an important "fur country."

This era of discovery, with its results, constitutes the first chapter in the known history of British Columbia. It is replete with the achievements and adventures of these pioneers of commerce, who with their limited resources, and without knowing that they had achieved fame—often without even placing their journeys on record—extended the operations of their Companies across a continent. But this chapter, though full of interest, is not that with which we are at present concerned. It must suffice to say that what is now British Columbia remained a "fur country," and that alone, for many years. The existence of coal upon its coast was recognized by Dr. Tolmie, an officer of the Hudson's Bay Company, as early as 1835 ; but though small quantities of coal were actually obtained from natural outcrops from time to time, for the use of blacksmiths at the Company's posts, no importance appears to have been attached to the discovery. The world was at that time very spacious, and the Pacific Ocean was still regarded rather as a field for the exploration of navigators than as a highway of commerce between America and Asia.

* Paper read before the Royal Colonial Institute.

In 1849 gold was discovered in California, and with the resulting influx of miners, the seizure of that Mexican province by the United States, justified, if justifiable at all by its subsequent development, all are familiar. Two years later, a discovery of gold occurred on the Queen Charlotte Islands, now forming part of British Columbia. This constitutes an interesting episode by itself, but though some attention was drawn to it for a time, no substantial results followed, and no alteration in the condition of the country as a whole was brought about. The meaning and the worth of this particular discovery yet remained to be determined.

In 1857, however, four or five French-Canadians and half-breeds, employes of the ubiquitous Hudson's Bay Company, found gold on the banks of the Thompson, a tributary of the Fraser River, and their discovery becoming known, changed the whole fortunes of the country. California was at this time filled with gold miners, and it required only the rumour of a new discovery of gold to create a new "excitement." In the following year, it is estimated that within three months over 20,000 people arrived at the remote trading post which then stood upon the present site of the city of Victoria, while many more made their way overland to the New El Dorado.

The difficulties in the way of these fortune hunters were great. The country was without roads or other means of communication, save such rough trails and tracks as had served the purpose of the natives and those of the fur traders. The Indians, if not openly hostile, were treacherous, and not a few of the men who actually reached the Fraser Canons were never again heard of.

The Fraser and Thompson were at this time the objective points, and much of the lengths of these rivers were impracticable torrents. It is not therefore surprising that by far the larger part of those engaged in this sudden migration returned disappointed, many without ever reaching their destination. Some, however, persevered, several thousand miners actually got to work on the auriferous bars of the Fraser, and a new state of affairs was thus fairly inaugurated.

To follow the rapid progress of these miners along the Fraser and Thompson with their tributaries would be full of interest, though the records of their work now existing are scanty, but this again would lead us too far afield. The gold found on the lower reaches of the Fraser was what is known to miners as "fine" gold, or gold in very small scales or dust, minutely divided. Further up "coarser" gold was obtained, and the miners very naturally jumped to the conclusion that somewhere still further up the great stream the source of all the gold should be found. Thus, with restless energy, they pushed on till before long the Cariboo country, some 400 miles from the sea, was reached; and here the richest deposits of alluvial or "placer" gold were found, and for a number of years continued to be worked, with results which, considering the comparatively small number of men engaged, were most remarkable.

Later and more thorough investigations show that the theory so readily adopted by the miners was incorrect; that there is no regular gradation in amount or "coarseness" of gold from the lower part of the Fraser to the head waters in Cariboo, but that the gold found on the bars of the river, is of more local origin. Still the theory referred to, as a matter of fact, led the miners to Cariboo, which proved not only to be the richest district so far discovered in British Columbia, but for its area one of the richest placer mining districts ever found.

In this district the valleys of two streams, Lightning and Williams Creeks, have been most remunerative, and these and their tributaries have actually yielded the greater part of the gold obtained. The work was begun by the washing of the gravels of the streams themselves, but with the experience already gained in California and in Australia, the miners soon began to search deeper. The valleys through which these streams flowed were found to be filled to a considerable depth by loose material, gravel, and boulder-clay due to the glacial period or to inwash from the sides of the bordering mountain ranges; and in sinking beneath all this material the channels of older streams, the predecessors of the present, were found, with their rocky beds smoothed and worn and filled with rounded boulders and gravel. These contained vastly richer deposits of gold, because they represented the concentrated accumulations of great periods of continued work by natural forces of denudation and river action.

This discovery, once made, led to the initiation of more extended mining operations, which often necessitated large expense in labor and the construction of heavy pumping machinery; but the results as a rule repaid the enterprising miners. Thus the old deeply buried channel of Lightning Creek was found to average something like $200 in gold to each running foot of its length, while considerable lengths of Williams Creek yielded as much as $1,000 to the same unit of measurement.

Williams Creek affords some notable instances of the extraordinary concentration of "coarse" gold in limited areas:—Thus, from Steele's claim, 80 x 25 feet, over $100,000 worth of gold was obtained. From the Diller Company's claim, it is stated that in one day 200 lb. weight of gold, valued at $38,400, was raised; and in 1863, twenty claims were producing from 70 to 400 ounces of gold each per diem. Four hundred miners were at work on Williams Creek in this year, which is still admiringly spoken of as the "golden year."

Though, like Williams Creek, discovered in 1861, the deep channel of Lightning Creek was not successfully reached till 1870, but great developments followed. The Butcher claim at one time yielded 350 ounces of gold a day; the Aurora, 300 to 600 ounces; and the Caledonia, 300 ounces.

It must be remembered that the Cariboo mining district is situated in a high and densely forested mountainous region, which, because of its inaccessible character, had remained almost unknown even to the wandering native hunters. At the time in which these great discoveries in it occurred, it was reached only with extreme difficulty by trails or imperfect tracks, over mountains and across unbridged rivers. Every article required by the miner was obtained at an excessive cost; but all these drawbacks did not prevent the rapid growth of typical mining camps in the centre of this remote wilderness, with their accompanying lavish expenditure and costly if rude pleasures. So long as the golden stream continued to flow in undiminished volume, everything that gold alone could buy was to be obtained in Cariboo.

Perhaps more worthy of note is the fact that the development of these mines was carried out entirely by the miners themselves. No outside capital or backing was asked for or obtained. Money made in one venture was freely and at once embarked in another, and the investors were to be found working with pick and shovel in the shaft or drift.

But the lengths of the rich old channels on both these famous creeks which could be worked in this way proved to be limited to a few miles. Below a certain point in each case, the "bed rock" was found to be at so great a depth that it was not possible to reach it through the loose and water-saturated materials filling the old valley. Thus the great yield of gold became gradually reduced to comparatively modest proportions, and, at the present time, mining in the Cariboo district is mainly confined to hydraulic workings, by which poorer ground is utilized and a much larger quantity of material requires to be removed to obtain a given amount of gold. But the old valleys of Cariboo have never ceased to produce gold, and in 1892 their product still amounted in value to about $200,000.

It has been impossible to follow the fortunes of the Cariboo mining district in any detail, and time can only be afforded to name the other placer mining districts of the province. The Omenica district was discovered soon after Cariboo, but little was done there till 1867. This district is situated in latitude 56°, in the drainage basin of the Peace River, and, though so remote, has produced a considerable quantity of gold. Still further to the north, in latitude 58°, is the Cassiar district, first found to be auriferous in 1872, for some years thereafter resorted to by many miners, and still a mining centre not without importance. This is the northernmost mining region of British Columbia proper, but beyond the 60th parallel (forming the northern boundary of the province) alluvial gold mining has of late years been developed in the Yukon district, embracing the numerous upper tributaries of that great river, and extending to the borders of the United States territory of Alaska.

Neither must it be forgotten to note, that the working of alluvial gold deposits of greater or less importance has occurred at many places in the southern part of the province, to the East of the Fraser River, including Big Bend, Similkameen, and Kootanie districts, from all of which some gold still continues to be produced by the old methods.

The story of the discovery and development, the palmy days and the gradual decline in importance of any one of these mining regions, rightly told and in sufficient detail, would constitute in itself a subject of interest. But without attempting to do more than name the districts here, it is of importance to note how general, throughout the whole extent of the great area of British Columbia, the occurrence of deposits of alluvial gold has been proved to be. The gold thus found in the gravels and river-beds is merely that collected in those places by natural processes of waste, acting on the rocks, and the concentration of their heavy materials during the long course of time. The gold has been collected in these places by the untiring action of the streams and rivers, and it must in all cases be accepted as an indication of the gold-bearing veins which traverse the rocky substructure of the country, and which await merely the necessary skill and capital to yield to the miner still more abundantly.

Nevertheless, the results of alluvial or placer gold mining alone in British Columbia have not been insignificant, for, since the early years of the discovery, the province has contributed gold to the value of some $50,000,000 to the world.

One feature in particular requires special mention, and this is a deduction which depends not alone on experience in British Columbia, but which is based as well on that resulting from the study and examination of other regions. The "heavy," or "coarse" gold, meaning by these miners' terms the gold which occurs in pellets or nuggets of some size, never travels far from its place of origin. It is from this point of view that it becomes important to note and record the localities in which rich alluvial deposits have been found, even when the working of these has been abandoned by the placer miner. Their existence points to that of neighboring deposits in the rock itself, which may confidently be looked for, and which are likely to constitute a greater and more permanent source of wealth than that afforded by their derived gold.

Reverting for a moment to the Cariboo district, where such notably rich deposits of alluvial gold have been found within a limited area, and where, very often, the gold obtained has been actually mingled with the quartz of the parent veins, it cannot be doubted that these veins will before long be drawn upon to produce a second golden harvest. This district has suffered and still suffers from its great distance from efficient means of communication; but, notwithstanding this, praiseworthy efforts have already been made towards the development of "quartz mining," while much also remains to be done in utilizing by operations on a larger scale, and with better appliances, the less accessible placer deposits which have so far baffled the efforts of the local miner.

It is necessary to bear in mind that alluvial gold mining or placer mining requires but a minimum amount of knowledge on the part of the miner, though it may call for much individual enterprise and effort when a new and difficult region is to be entered. Any man of ordinary intelligence may soon become an expert placer miner. It is after all, in the main, a poor man's method of mining; and, as a rule, the placer miner lacks the knowledge as well as the capital necessary to enable him to undertake regular mining operations on veins and lodes. However promising the indications may be for such mining, he either does not appreciate them, or passes them over as being beyond his experience or means. He would rather travel hundreds of miles to test a new reported discovery, than spend a summer in endeavoring to trace out a quartz reef, with the uncertain prospect of being able to dispose of it at some later date.

Thus, though the development of placer mining in British Columbia began a new history for that great region, raising it from the status of a "fur country" to that of an independent colony, and subsequently to that of a province of Canada, there remained a gap to be bridged in order that the province should begin to realize its proper place among the mining regions of the world. It was necessary that railways should be constructed to convey machinery and carry ores, as well as to bring to the metalliferous districts men who would not face the hardships of pioneer travel in the mountains, but who are in a position to embark the necessary capital in promising enterprises.

For a portion of the province, the construction of the Canadian Pacific Railway has afforded these facilities, but by far the larger part still awaits railway communication. Had the Canadian Pacific Railway, in accordance with some of the surveys made for it, traversed, for instance, the Cariboo district, there can be no doubt that we should have already been able to note great developments there. This railway has, however, been constructed across the southern portion of the province, and in its vicinity, and concurrently with its progress, new mining interests have begun to grow up, of which something must now be said.

Before turning to these, however, I must ask to be allowed to say a few words respecting the development of the coal mines of British Columbia, which was meanwhile in progress.

The discovery of coal upon the coast, at an early date in the brief history of British Columbia, has already been alluded to. Following this discovery, the Hudson's Bay Company brought out a few coal miners from Scotland, and proceeded to test and open up some of the deposits. Thus, as early as 1853, about 2,000 tons of coal were actually raised at Nanaimo. San Francisco already began to afford a market for this coal, and the amount produced increased from year to year. The principal coal-mining district remained, and still remains, at Nanaimo, on Vancouver Island. At the close of the year 1888, about four and a half million tons in all had been produced, and the output has grown annually, till in 1891 over a million tons were raised in one year. California is still the principal place of sale for the coal, which, by reason of its superior quality, practically controls this market, and is held in greater estimation than any other fuel produced on the Pacific slope of North America. The local consumption in the province itself grows annually, and smaller quantities are also exported to the Hawaiian Islands, and to China, Japan, and other places. In the various ports of the Pacific Ocean, the coal from British Columbia comes into competition with coal from Puget Sound, in the State of Washington, which, because of the high protective duty established by the United States, is enabled to achieve a large sale in California notwithstanding its inferior quality. It also has to compete with shipments from Great Britain, brought out practically as ballast, with the coals of Newcastle in New South Wales, with coal from Japan, and in regard to the Pacific ports of the Russian Empire, with coal raised by convict labor, at Duai, on Saghalien Island, in the Okotsk Sea.

It is sufficient guarantee for the quality of the coal of British Columbia that it is able to hold its own as against all these competitors.

Though Nanaimo has been from the first the chief point of production of coal, work has been extended within the last few years to the Comox district, also situated on Vancouver Island; while other promising coal-bearing tracts have been in part explored and examined on this island, and on the Queen Charlotte Islands.

These particular coal regions, bordering upon the Pacific Ocean, have naturally been the first to be employed, but they by no means exhaust the resources of the province in respect to coal. Deposits of good bituminous coal are known also in the inland region, and some of these in the vicinity of the line of railway are now being opened up, while others, still far from any practicable means of transport or convenient market, have been discovered, and lie in reserve. One of the most remarkable of these undeveloped fields is that of the Crow's Nest Pass, in the Rocky Mountains, where a large number of superposed beds of exceptional thickness and quality have been defined.

Besides the bituminous coals, there are also in the interior of the province widely extended deposits of lignite coals, of later geological age, which, though inferior as fuels, possess considerable value for local use.

In the Queen Charlotte Islands anthracite coal is found, but has not yet been successfully worked; and in the Rocky Mountains, on the line of the Canadian Pacific

Railway coal of the same kind again occurs, near Banff and Canmore stations. The places last named lie just beyond the eastern border of British Columbia in the adjacent district of Alberta, but require mention in connection with the mineral resources of the province.

The coals of British Columbia may, in fact, be said to represent, in regard to quality and composition, every stage from hard and smokeless fuels, such as anthracite, to lignites and brown coals like those of Saxony and Bohemia. Many features of interest to the geologist might be mentioned in relation to these coal deposits did time permit, but it must not be forgotten to note one principal fact of this kind—the very recent geological age to which all the coals belong. None of the coals of British Columbia are so old as those worked in Great Britain; they are, in fact, all contained in cretaceous and tertiary rock.

The general distribution of coals of various kinds in different parts of the province is of peculiar importance when considered in connection with the building of railways and the mining and smelting of the metalliferous ores. It insures the most favorable conditions for the development of these ores, to some further examination of which we must now return.

It is especially worthy of note, that wherever in the United States, the Rocky Mountain or Cordilleran region has been traversed by railways, mining, and particularly that of the precious metals, has immediately followed. It appears to require only facilities of transport and travel to initiate important mining enterprises in any part of this region. The building of the Canadian Pacific Railway across the southern part of British Columbia, with the construction of other railway lines in the neighboring States, near the frontier of the province, have already begun to bring about the same result in this new region; which, till these railways were completed, had remained almost inaccessible. It had long before been resorted to by a few placer miners in search of alluvial gold, and their efforts were attended with some success. Silver-bearing lead ores were also found to occur there, but under the circumstances existing at the time these actually possessed no economic value. It was impossible to utilize them.

In 1886, some prospectors, still in search of placer gold only, happened to camp in a high mountainous region which has since become familiarly known as Toad Mountain, and one of them, in seeking for lost horses, stumbled on an outcrop of ore, of which he brought back a specimen. This specimen was afterwards submitted to assay, and the results were such that the prospectors returned and staked out claims on their discovery. The ore, in fact, proved to contain something like $300 to the ton in silver, with a large percentage of copper and a little gold.

In this manner what is now known as the "Silver King" mine was discovered, and, as a consequence of its discovery the entire Kootanie district, in which it is situated, began to be overrun with prospectors. Hundreds of these men, with experience gained in the neighboring states of Montana and Idaho, as well as others from different parts of the world, turned their attention to Kootanie. The result has been that within about five years a very great number of metalliferous deposits, chiefly silver ores, have been discovered, and claims taken out upon them. Several growing mining centres and little towns have been established; roads, trails, and bridges have been made, steamers have been placed on the Kootanie Lake and on the Upper Columbia River, and a short line of railway has been built between the lake and river to connect their navigable waters. The immediate centre of interest in regard to mining development in British Columbia has, in fact, for the time being, been almost entirely changed from the principal old placer mining districts to the new discoveries of silver-bearing veins.

So far as they have yet been examined or opened up, the metalliferous deposits of the Kootanie district give every evidence of exceptional value. They consist chiefly of argentiferous galena, holding silver to the value of from $40 or $50 to several hundred dollars to the ton. Nelson, Hot Springs, Kaslo, Slocan, Illecillewaet and Golden are at present the principal recognized centres in the new district, but it would be rash as yet to attempt to indicate its ultimate limits.

Though much has already been done in this Kootanie district, two principal causes have tended to prevent the more rapid growth of substantial mining up to the present time. The first of these is the difficulty still existing in respect to the local transport of large quantities of ores; the second, the exaggerated values placed by discoverers upon their claims. While it is evidently just that the prospector should receive an ample remuneration for his find, it is to be noted that the laws of British Columbia are so liberal that he (whatever his nationality) may, at a cost scarcely more than nominal, hold and establish his claim, even though he may be practically without means of developing it. Such development in all cases requires the expenditure of considerable sums, and this must always be of a more or less speculative character, while, even if thus fully proved, it becomes further necessary to incur an additional large expenditure in plant and machinery before any property reaches the status of a going concern. Scarcely an instance can be quoted anywhere of a mine which has paid its own way from the "grass" down, but almost every prospector is fully convinced that his claim is precisely of this kind.

Such circumstances, which have unfortunately for the last few years retarded the development of the Kootanie country, are now happily passing away; and there can be no reasonable doubt that in the next year or two this country will establish its place as one of the most important, not only in British Columbia but in North America as a whole.

So far as England is concerned, the actual investment of capital in this district has been small. The investor here would rather pay half a million for some property which, as demonstrated in a prospectus, will produce a good annual rate of interest, than embark a comparatively small sum in a promising venture. But to a man with some knowledge of mines and mining and the command of even a limited amount of capital, who will visit and live in the district himself for a time, the opportunities for profitable investment are, I believe to-day, excellent.

I have been unable to say anything in detail in regard to the actual modes of occurrence of the ores now being brought to light in the Kootanie district and their geological relations. Neither is it practicable, on the present occasion, to pursue in further detail the history or description of other districts of the province in which more or less good work of a preliminary kind has been done in the development of metalliferous deposits of various kinds. Okanagan, Rock Creek, Nicola, Similkameen, the North Thompson and Cayoosh Creek can only be named. It has been possible merely to endeavor to indicate in broad lines what has already been done and what must soon follow. Within a few years this province of Canada will undoubtedly hold an important place in the list of quotations of mining stocks in London and elsewhere, and then the further development of its mines will become a subject of common interest from day to day.

In conclusion, I wish to draw attention to one or two ruling features of the actual situation which are too important to be left without mention:—

The Cordilleran belt, or Rocky Mountain region of North America, forming the wide western rim of the continent, has, whenever it has been adequately examined, proved to be rich in the precious metals as well as in other ores. This has been the case in Mexico and in the western States of the American union. Though some parts of this ore-bearing region are undoubtedly richer than others, generally speaking it is throughout a metalliferous country. The mining of placer or alluvial gold deposits has in most cases occurred in advance of railway construction; but this industry has always proved to be more or less transitory in its character, and has almost invariably been an indication of future and more permanent developments of a different kind. Placer gold-mining has, in fact, often been continued for years and then abandoned, long before the gold and silver-bearing veins in the same tract of country have been discovered and opened up. This latter and more permanent phase of mining has followed the construction of railways and roads, and the series of conditions thus outlined are repeating themselves in British Columbia to-day.

There is no reason whatever to believe that the particular portions of British Columbia now for the first time opened to mining by means of the Canadian Pacific Railway, are richer in ores than other parts of the province. On the contrary, what has already been said of the Cariboo district affords *prima facie* evidence of an opposite character. The province of British Columbia alone, from south-east to north-west, includes a length of over 800 miles of the Cordilleran region; and, adding to this the further extension of the same region comprised within the boundaries of the Dominion of Canada as a whole, its entire length in Canada is between 1,200 and 1,300 miles. This is almost identical with the whole length of the same region contained within the United States, from the southern boundary with Mexico to the northern with Canada.

Circumstances have favored the development of the mines of the Western States of the Union, but it is, as nearly as may be, certain, that the northern half of the similar region will eventually prove equal in richness to the southern, and that when the mines of these Western States may have passed their zenith of productiveness, those of the north will be still increasing in this respect. The explorations of the Geological Survey of Canada have already resulted in placing on record the occurrence of rich ores of gold and silver in various places scattered along the entire length of the Cordilleran region in Canada, and though so far we have to chronicle only an awakening of interest in the southern part of British Columbia, these discoveries stand as indications and incentives to further enterprise to the north.

While the remote and impracticable character of much of this northern country places certain obstacles in the way of its development, on the other hand the local abundance of timber and water power in it afford facilities unknown in the south, which will be of importance whenever mining operations have actually been set on foot.

No attempt has been made in this brief sketch of the mineral wealth of British Columbia to enumerate the various ores and minerals which have so far been found within the limits of the province in any systematic manner. Nothing has been said of the large deposits of iron, from some of which a certain amount of ore has already been produced, and which wait to realize their true importance, merely the circumstances which would render their working on a large scale remunerative. Copper ores have also been discovered in many places. Mercury, in the form of cinnibar, promises to be of value in the near future, and iron pyrites, plumbago, mica, asbestos, and other useful minerals are also known to occur. In late years platinum has been obtained in alluvial mines in British Columbia in such considerable quantity as to exceed the product of this metal from any other part of North America.

While, therefore, the more important products of this western mountain region of Canada are, and seem likely to be, gold, silver and coal; its known minerals are already so varied, that, as it becomes more fully explored, it seems probable that few minerals or ores of value will be found to be altogeter wanting.

Respecting the immediate future of mining, which is the point to which attention is particularly called at the present time, it may be stated that coal mining rests already on a substantial basis of continued and increasing prosperity; while the work now actually in progress, particularly in the southern part of the province, appears to indicate that, following the large output of placer gold, and exceeding this in amount and in permanence, will be the development of silver mines, with lead and copper as accessory products. The development of these mining industries will undoubtedly be followed by that of auriferous quartz reefs, in various parts of the province, while all these mining enterprises must react upon and stimulate agriculture and trade in their various branches.

Because a mountainous country, and till of late a very remote one, the development of the resources of British Columbia has heretofore been slow, but the preliminary difficulties having been overcome, it is now, there is every reason to believe, on the verge of an era of prosperity and expansion of which it is yet difficult to foresee the amount or the end.

Discussion.

THE CHAIRMAN—I will first call upon Sir Joseph W. Trutch, a former Governor of British Columbia, than whom I know no greater authority on that province of Canada.

SIR JOSEPH W. TRUTCH, K.C.M.G.—I have listened, in common, I am sure, with all present, with the greatest pleasure to Dr. Dawson's address. The subject is of great general interest to all—but of special importance to those who, like myself, are connected with British Columbia by bonds of sentiment and material interest. Like everything else of a similar character that has emanated from Dr. Dawson, that address bears the stamp of careful consideration and of the great practical ability of its author. British Columbians well understand and very gratefully acknowledge the obligations they are already under to him for many similar reports of his explorations and opinions in reference to their country, and I am sure I express their sentiments in anticipation in thanking him as I do for his further very valuable paper to-night. In it he has shown how we might confidently have anticipated from the geological point of view that British Columbia would be found a rich mineral country; and he has told us, from the results of his own explorations and experiences, to what extent those anticipations have been realized by him, and has given us a carefully drawn opinion as to the ultimate value of that mineral district. I do not think that any remarks of mine, detailing the observations and experiences and conclusions of a cursory character of inexpert like myself, would be useful or acceptable after this able and exhaustive address; I will only say that certainly all my experience in that country, extending now over thirty-five years, and the experience of all those more immediately engaged in mining pursuits, fully confirm all that he has told you of the particular features of that country; and, further, that the opinions and expectations entertained in that country with reference to the future development of that mineral district are of the most hopeful—I might, perhaps, almost say, in some cases, of a sanguine character. They have been so indeed for years past, and since I have been away from the province now some twelve months, I continue to receive from my correspondents there reports of discoveries and developments in that country, particularly in the Kootanie district, which fully maintain and strengthen all previous anticipations. I should like to say also, in confirmation of Dr. Dawson's address upon the more general topics of the country, that the conditions under which its mineral wealth, whatever it may be found to be, are to be developed, are surely of a most favorable character—favorable from considerations of climatic conditions, of conditions of location, and of conditions of a more general character. As regards climatic conditions, you will allow me to say, in a word or two only, as this is one of the subjects on which British Columbians are apt to "enthuse" a great deal, that whether in the more equable temperature prevailing along the sea coast and in the valleys leading up into the mountains, or in the interior districts, with greater cold in winter and greater heat in summer, everywhere free from those malarial influences so common in most new countries, you have a climate under which, more truly, I believe, than of any part of the world, it may be said that labor itself is pleasure. Then as regards conditions of location, the times are past, not so long ago, however, when British Columbia was isolated by intervening tracts of mountain and uninhabited prairie, which cut her off from Canada, and rendered the sea the only means, practically speaking, of approach to that country; when, as Dr. Dawson has told us, access into the interior districts could only be had at the price of great endurance and at the peril of life. In those days, so difficult were the means of transport into the interior and the mining districts, such as Cariboo, that it was commonly said that a pound of salt was worth as much there as a pound of tea, or of any other commodity the intrinsic value of which was infinitely greater. Those days have happily passed away. Since the construction of that great transcontinental railway—thanks to the enterprise and courage of the gentlemen who form the Canadian Pacific Railway Company, thanks to their enterprise in initaiting and constructing that line under ihe auspices of the patriotic Government of Canada, and under your immediate able direction, Mr. Chairman, we now have railway communication through our country, and from our country through Canada to the Atlan

Ocean: a railway second to none on the continent, nor indeed, under all the circumstances, to any railway in any part of the world. That railway has already afforded the means of introducing machinery into some of our mining districts. The same enterprise—the enterprise of the same company and of other kindred railway corporations—has extended, or is extending, branch railways into the Kootanie country; and, as Dr. Dawson has said, nowadays you have no longer the same great difficulties to contend with. Machinery can now be introduced, and food obtained, at reasonable prices. And then, as to conditions of a more general character, bear in mind that nowhere else is British law more effectively maintained and administered, and consequently life more secure, and the rights of property more fully assured, and in particular, that the Mining Laws and Regulations, based on years of experience, have been framed with the special aim to encourage and promote the development of the minerals in the country, and to protect mining rights and property. I only desire, in conclusion, to express the hope and wish that, however many may be induced to embark their capital, and time, and energy in British Columbia in the pursuit of fortune from its mineral wealth or its many other resources, I trust they may all realize this result, at least: a result which, happily for me, I stand here prepared to profess and maintain, that British Columbia, if not the richest, is, at all events, the happiest country in the world.

MR. H. C. BEETON (Agent-General for British Columbia). In the first place, I beg to congratulate the Fellows of the Royal Colonial Institute on securing the valuable services of Dr. Dawson on this occasion, notwithstanding the very important duties which brought him to this country, in connection with the Foreign Office; and on behalf of the province, I wish to express my hearty thanks for his very able and interesting paper. It is quite certain we could not have had a higher authority on this subject. He knows the province most intimately, having travelled over the greater part of it, and from his knowledge as an expert he has given to the world in his works an exhaustive geological account of it. He has traversed familiar ground this evening, and he has reassured my mind—if indeed I ever had a doubt, about the brilliant future of the province. Dr. Dawson pointed out that, having passed through the placer period of mining, we have entered the deep-sinking and the quartz-mining period, which will naturally require a great deal of capital, machinery, and, of course, skill. The difficulty is to attract foreign capital to distant enterprises of a speculative character, which mining must always be. Consequently, the Americans have an advantage over the English, being nearer the spot, and they have also the advantage of experience in their own country, and, as we see, they are now working their way north and developing this rich Kootanie district. At the same time we are indebted to the Canadian Pacific Railway for the present development very much. British Columbia has been kept back mainly owing to the want of such communication, but I have no hesitation in saying that we are now on the eve, in this Kootanie district of the South-East province, of very important and most valuable mineral developments; and though one speaks with 'bated breath about paying mines after what I have listened to this evening, I have no hesitation in saying that this summer will demonstrate to the world that the Kootanie district will not only prove valuable but be a good paying district. Dr. Dawson has referred to the Cordilleran belt, which, as geologists know, exists not only in British Columbia and Montana and California, but further south; and so confident are our American cousins of the mineral wealth of this formation, of which we have over a thousand miles in our province, that I have myself seen a project on paper, which I should not be astonished to see one day carried out, for a railway running north and developing this rich mineral belt. The railway will extend to Alaska, and then, crossing the Behring Straits, will connect with the railway which I believe is about to be commenced in Russia, connecting finally with the European system; so that it is on the cards that our posterity will he able to go overland from British Columbia to the city of London. This will give you some idea of the opinion of our American cousins as regards this belt. Although I should be the very last to depreciate the importance of mineral wealth, there is no doubt it plays a very important part in the development of our Colonies, as witness Australia and the Cape; but experience tells us that for permanent sources of wealth we must look further than minerals. So British Columbia must look to the permanent sources of wealth she possesses in her fisheries, forests, and coal mines; and I think that in the near future we shall, like our neighbors to the south, have another industry—a most important one—the fruit industry. For years, California has sent to our markets enormous quantities of preserved fruits. There is no reason in the world why British Columbia should not add fruit to her export list; we are on the eve of that business, and I hope to have the good fortune of exhibiting what we can do in that respect in our court at the Imperial Institute. I beg to thank Dr. Dawson for the valuable assistance he has rendered me at the Imperial Institute in the arrangement of the mineral cases, and I hope, and am sure, that I shall in the future have his continued assistance in carrying out what we have so much at heart—viz., that the public may know what we are doing and have done in regard to minerals, and that those mineral cases will contain a permanent representation of our mineral resources.

DR. JOHN RAE, F.R.S.—I have gone over part of the country in British Columbia described by Dr. Dawson, namely, the Cariboo district, when the gold mining was in full swing; my object in going there was not to look after gold, but to search out the safest and easiest route by which to take a telegraph line across the continent, which the Hudson's Bay Company were desirous of carrying out—as there was a very promising-looking valley leading from Cariboo to the head waters of the Fraser River. My hopes in that direction were disappointed, nor could I examine the place closely, the ground at the time being covered with snow. It was altogether a rather rough journey, as we had to run down the dangerous Fraser River in very small "dug-outs," a thing never previously done by strangers, I was told, without guides, the Shushwapp Indians being unable to accompany us. I did a little gold-washing in the streams we passed by both east and west of the Rocky Mountains, and found color of gold more or less developed almost everywhere. At one small stream east of the Rocky Mountains I stumbled upon what appeared to be a fine outcrop of coal at least eleven feet thick, which was found to burn well, and boiled our kettle very nicely, but a sample I brought home and took to Jermyn Street Geological Museum was pronounced by Sir Andrew Ramsay to be only lignite. I have no doubt I showed my ignorance in expressing an opinion that *possibly*, as this outcrop had been exposed for hundreds of years to the changes of the weather, perhaps when mined deeper it would be different. It looked so very pretty and clean to handle. If I may wander away a little northward and eastward from British Columbia, I would say a word or two about the abundant indications of copper at and near the Coppermine River on the Arctic Coast, where we picked up some lumps of six or eight pounds' weight that appeared perfectly pure; in fact so pure that all the weapons and tools of the Eskimos are manufactured of this metal. The Indians, also, when they run short of lead, hammer lumps of copper into a substitute for balls for their guns. From my description of the rock formation, Dr. Dawson is of opinion that it is similar to or part of the copper-bearing rock stratum of Lake Superior. My object in getting on my legs was most surely not to say anything about myself, but on a more agreeable subject: to say a word about my friend, the reader of to-night's paper; whom I knew and saw a good deal of at home, when as a lad he was a student of geology in London, and how we were delighted with his intelligence and capacity—an opinion fully confirmed by a very high authority, Sir Andrew Ramsay, at that time at the head of the Geological Survey of Great Britain, who said he never had a student who showed more application and quickness in acquiring knowledge of his subject than Dr. Dawson—and thus the boy was father to the man. Dr. Dawson has done me the favor to send me from time to time many of the interesting papers he has published, not always geological, and I can testify to the immense amount of work they display, sometimes performed in very difficult and trying circumstances. They are full of important facts, and one can rely upon every word in them. He has shown what he can do, and I venture to express a belief that there is a great future before him.

MR. W. S. SEBRIGHT GREEN—As an old British Columbian, I have listened with great pleasure to Dr. Dawson's able address. The only fault I have to find is with the map on the wall, which makes the country look so rocky, lifeless, and inhospitable. Now, it is a glorious country. For climate and a happy life there is no country equal to it. The future of British Columbia no doubt is a great future. Its gold and other mineral resources must be developed. I have washed a pan or two out there in the days Dr. Dawson speaks about—the golden year 1863. It was a hard country, the Cariboo country, in those days, for there was no railway and travelling was very rough work. I walked through the snow from Lightning Creek to Williams Creek, and when I got to my journey's end I had to lie on the bare boards and was glad to get a sheepskin to cover me. But the Canadian Pacific Railway has changed all that. British Columbia is not so far off as it was. It can be reached now from London in little over a fortnight. In the sixties it took you about six weeks. Irrespective of gold, there is a future before British Columbia, for, notwithstanding that there are so many mountains, there is a great deal of really good land. I have ridden over miles of rolling prairie among those mountains, and beyond that there is no doubt a vast quantity of mineral wealth yet undiscovered. Speaking of the Kootanie district, I myself, in 1864 or 1865, had several specimens of the richest silver ore I ever saw in my life. The prospector who gave them to me told me he would divulge the secret of its whereabouts to me some day, but he wanted to see a little more it; and the secret, I believe, died with him. As to the gold, I have been told of a prospector who goes regularly every year to Victoria with gold dug by himself. He has kept the secret, but it is to be hoped it won't die with him. I should have been glad if Dr. Dawson had told us what he thought of the gold of Vancouver Island itself. There was a quantity of gold taken out of Leach River in 1865, but mining was not continued there beyond a few months, although there must be still gold there. I may say, in conclusion, that those who have any idea of investing money in gold or coal mines, in my opinion could not do better than go to British Columbia.

MAJOR WILLIAM CLARK—I have not had Dr. Dawson's experience of British Columbia, neither have I his scientific knowledge; I have not lived so long in that province as my friend Sir Joseph Trutch, and have not at any time held the position of Agent-General which Mr. Beeton so worthily occupies; but I do not yield to any of these gentlemen in the faith I have in the future of British Columbia. I have to thank Dr. Dawson for the paper which he has just read: it strengthens my faith in what I myself believe, and one is always ready to take hold of evidence in support of his own conclusions. We must remember that Dr. Dawson occupies an official position, and must, therefore, be extremely guarded in his statements. Were he free to "boom" British Columbia he would, no doubt, have let his tongue loose, and have said things which would have been more suitable for the promotion of mining companies; but it is right, and all the more valuable, that so high an authority should keep well within the mark. We have read somewhere that the Queen of Sheba, when she came to see the glory of Solomon, exclaimed that "the half had not been told" her; and I dare say, if any of this audience not personally acquainted with British Columbia were to go out and examine into matters as carefully as Dr. Dawson has done, the Queen of Sheba's certificate would be most applicable. We have been recently informed that Her Majesty belonged to a highly mineralized country, and it may have been that the Assistant Director of the Geological Survey of her dominions was her cautious informant. Joking apart, I feel sure that this contribution to our knowledge of British Columbia comes at an opportune time. We have lately heard a great deal about South Africa and of the sums invested in the development of that portion of the Empire, but firmly believe that it will well repay those who are pinning their faith on South Africa to follow up the lead which Dr. Dawson has given us to-night. I have nothing to say against South Africa, but investors will be quite safe to go on the information Dr. Dawson supplies; and considering the nearness of British Columbia, I would strongly recommend it as another basket into which part of the investors' eggs could with safety be deposited. Dr. Dawson has only had time to-night to indicate what possibilities lie in that province, and to touch on some of its leading features as a mineral country. He has passed over the question of placer mining with a few remarks regarding the early days of the placers, but it would be a mistake to infer that he considers these as by any means exhausted. I think Sir Matthew Begbie is authority for the statement regarding the "flour" or "scale" gold, that there is not a spadeful of soil on the benches of the Fraser and Thompson Rivers that isn't auriferous; and I believe that when proper appliances are brought to bear upon these benches and on the channels of the upper country, the results will outweigh those realized by the crude methods of the past. Working with shovel and cradle for the most part, and with no capital but the result of their daily toil, the miners had to be content with the products of the upper gravels. In many cases, where they were able to break through and reach the older deposits, as in Lightning Creek, the miners were "drowned out" when the pay was at its best. These claims remain to this day, and there are hundreds of miles of gravels within the province capable of returning large dividends on capital judiciously applied to working by more modern and scientific methods. It must be gratifying to everyone present—remembering that British Columbia is an integral part of the British Empire—to be made aware of Dr. Dawson's estimate of the country from the forty-ninth parallel to the Alaskan frontier. His words are in the highest degree encouraging, and indicate that when mining results have passed their zenith, in that equal stretch on the American side of the boundary line, British Columbia will be mounting upwards to greater prosperity, enriching the province and the Empire. The province, as has been remarked, is Imperial in its dimensions. It is about one-third larger than the German Empire. It stands on four pillars as regards its future, for besides its wealth of minerals, it has its forests, its nsheries, and its agriculture to support its population. This province, with its enormous extent and its equally enormous resources, contains only about 100,000 people, and the value of its resources can best be realized from the fact that this handful of people—less than half the population of an ordinary English town—were able to export last year surplus products to the value of over six and a-half millions of dollars. Results so remarkable surely serve to indicate that there is room for the application of capital, and especially of British capital, for the development of these varied resources. Ever alive to what will pay, our American friends are steadily gaining a foothold. They cannot be blamed, but we will be liable to blame if we do not step in and do the work which it is peculiarly England's duty and England's privilege to accomplish; and for my own part I would rejoice to see some really practical outcome in that direction as the result of to-night's meeting. There are unique opportunities for the investment of capital in the mines and forests, and in the industries to which their products lead. These will eventually give employment to a large population, which will be the best guarantee for a home market for those engaged in agricultural pursuits. The wants of the present population are inadequately supplied, and each year large quantities of every kind of farm, orchard, and garden product have to be imported. It will readily be understood that the prospect of a permanent home market will attract agriculturists, as against other districts which have to rely on export prices for their returns. The range of land suitable for the farmer of small means is limited, but large areas exist which would form the basis for profitable returns on capital employed in converting these into manageable holdings, to the benefit alike of the capitalist and the country. I will not venture to say anything of the fishery wealth of British Columbia, or the bearing which this resource has on the future importance of the province. I am afraid I would get too enthusiastic, but it is without doubt that these fisheries will constitute one of its most permanent sources of revenue. In the departments of fishing and agriculture there are opportunities for colonization which, if prudently carried out, will be productive of the happiest results; and I am sure that patriotism, philanthropy, and cold capital, with an eye to

dividends, can safely join hands in furthering these truly Imperial interests. It has been my good fortune, under the guidance of our Chairman, the High Commissioner for Canada, to follow closely in recent years matters relating to the colonization and development of the Dominion, and in working out these interesting and important problems, and I am proud to recall the fact that it has been my privilege to serve under such a master.

DR. RANKINE DAWSON—I fear that I am not qualified to add anything of value to what has been already so well said, as regards the mineral wealth of British Columbia. As, however, the discussion has not been confined to this point, I may perhaps be allowed to say something of another characteristics of this great province for which, I venture to think, it will in future be as famous as it will undoubtedly be for its mineral wealth—I refer to its scenery. We have been told, as regards its mineral wealth, that much of it is at present inaccessible. The same is true of its scenery. Two sections of the country are, however, easily reached at the present time by the ordinary traveller, and of those only I shall speak. One is the line of the Canadian Pacific Railroad, which crosses at right angles three distinct mountain ranges on its way to the coast; the other is the coast itself, which extends over 500 miles from the international boundary on the south of Alaska. The mountain scenery is as fine as any to be found on the continent of America, and, so far as I know, is excelled only in grandeur and impressiveness by that of the Himalayas as seen from the neighborhood of Darjeeling. The Canadian Pacific with the foresight and enterprise for which that company is justly famous, has provided hotels at different points of exceptional beauty or interest, where artists, tourists, or sportsmen can obtain comfortable accommodation. Such are to be found at Banff and at Field in the Rocky Mountains, at Glacier, at the summit of the Selkirks, and at North Bend in the Coast Range. The scenery along the coast is of a different kind; there, long fjords and inlets cut up the coast line in the most fantastic way, whilst innumerable islands extend along its length, and form in many places natural channels, through which the traveller can pass for many miles without catching any glimpse of the open sea, whilst on either hand pine-covered mountains rise, almost precipitously, to a great height. In two other parts of the world only, so far as I know will similar scenery be found—viz. in Norway, and on the Western Coast of New Zealand. This voyage along the coast is already becoming a very popular one with tourists, and comfortable steamers ply at regular intervals throughout the summer season. Few things, perhaps, are more difficult to describe adequately than mountain scenery. It is not difficult to heap up adjectives, or to gradually advance from positive to comparative and superlative; but it is difficult indeed to convey real or definite conceptions to the mind of the listener. I shall make no such attempt to-night. This whole region well deserves the name which, in writing to the *Times* some two years ago, I ventured to give it: that of the Canadian Alps. In conclusion, I can confidently advise anyone who appreciates nature in its grandest and most impressive moods to take the earliest opportunity of visiting this great province for himself, and can promise him that he will not come away disappointed.

MR. JOSEPH NELSON—I made my first visit to British Columbia in the autumn of 1856. I worked the cradle on the Fraser River for the purpose of discovering gold, and I made the acquaintance of Sir James Douglas and Captain Cooper. The evidence I obtained I laid before Lord Taunton, then Secretary of State for the Colonies; a committee of the House of Commons having at that time been formed for the purpose of inquiring into the possibility and feasibility of colonizing the great North-West and British Columbia and Vancouver. I never formed a more favorable opinion of any country than I did of Vancouver and British Columbia during my short visit, and when I came back I wrote a handbook on the subject. At that time the discovery of gold was only beginning, and the result of the information which I had personally collected or received from various correspondents, and which I published, was that there was a considerable emigration to these parts. But the time came when the alluvial deposits were exhausted, and then they had to resort to more expensive methods. Gold was discovered up in Cariboo, but it was far removed from any means of communication, and the consequence was, the miners suffered great hardships. But that there was enormous mineral wealth there cannot be denied. I am speaking on the authority of one of the most successful miners of the present day—Mr. Mylchrest, who afterwards went to California and Australia, and then to South Africa, and who is now known as the great Diamond King. He was one of the pioneers, and had to undergo all these privations in consequence of the difficulties of getting provisions and the like. I was talking to him a few days ago on his visit to London—he is now one of the principal land owners in the Isle of Man—and he said: "I shall never forget the days I spent there; they were days of great privation; but there is a great future for that country when communication by rail is really opened up, and I have no doubt it will become one of the great gold producing countries of the north-west coast of America." On my return after my visit in 1856 I wrote a handbook, as I have already stated, and I said, "What is this distant country? The first thing to be done is to have steam communication with San Francisco," and I got up a company and spent a considerable sum of money, but did not succeed. The next thing I said was, "We will start a bank," and I obtained a Royal Charter. That is the Bank of British Columbia. I also proposed the construction of a railway, and that now forms part of the Canadian Pacific. Being a modest man, I will say no more on these matters, but this I must say—that I have read Dr. Dawson's contributions to geological knowledge with infinite pleasure. I may add that the present Lieutenant-Governor of British Columbia is practically experienced in mining matters, and when I heard of his appointment I felt that the right man had been put in the right place. Under him, I believe there is a great future before British Columbia. At the same time, we must always remember that mining is ephemeral, while the fisheries are perennial; still, as I have said, I believe that the mining industry will be developed, and that in this as in other respects the country will go on and prosper.

THE CHAIRMAN—A very agreeable duty now devolves upon me. It is to move a vote of thanks to Dr. Dawson for the very able and interesting paper he has presented to us this evening. I may mention that more than twenty years ago the Government of which I had the honor to be a member appointed Dr. Dawson a member of the Commission for the survey of the international boundary, and we were not disappointed in the result. On the completion of that important work, he presented the world with a most valuable volume on the scientific points which had presented themselves in connection with the flora and natural history and other important matters connected with the survey. From that time he has steadily ascended, step by step, until he has attained very nearly if not the same rank as his distinguished father, Sir William Dawson. I have no hesitation in saying that he has done most valuable work for Canada and for British Columbia, and for every person interested in that important part of Her Majesty's dominions on which the paper has treated. As a man of science he has been cautious, and has not over colored his picture; but although I am not a prophet, I venture to say that the mineral resources of British Columbia will continue to attract more and more attention until the world is astounded at the developments in that direction. I have great pleasure in moving a vote of thanks to Dr. Dawson.

The motion was cordially passed.

DR. DAWSON—I have to thank you for the attention with which my paper has been received this evening, and to express also to gentlemen who have joined in the discussion my appreciation of the terms in which they have spoken of such work as I have been able to do in British Columbia. It has been particularly gratifying to find how many friends of British Columbia are present. Had we a longer time to discuss the prospects and resources of that province, many additional points of interest upon which it has been impossible to touch would occur. My difficulty has been, in endeavoring to speak on so large and important a subject as that of the mineral wealth of British Columbia, to know where to stop, for in a general sketch such as that attempted to-night it is not possible to include details which must always be more interesting than the mere skeleton of the subject. It is now my pleasing duty to ask you to join in a vote of thanks to the Chairman. Sir Charles Tupper's work in connection with Canada is so well known, his interest in this Institute, as well as in all other matters connected with the welfare of the Empire at large, is so fully recognized, that it would be presumption on my part to say more in submiting this motion.

The chairman thanked the meeting, and the proceedings terminated.

Mining in the North-West Territory.

In his report to the Minister of the Interior for the year ending 31st October last, Mr. Wm. Pierce, Superintendent of Mines writes as follows:—

Canmore Coal Mines—Development work in these mines has been actively prosecuted since my last annual report, and the output is now, or shortly will be, in the neighborhood of 300 tons a day.

Canada North-West Coal and Lumber Syndicate, (Limited.)—Since my last report, development work has been carried on continuously, though not very extensively.

H. W. McNeill Co., Ltd., Anthracite.—During last summer work on this mine was shut down, as the demand for anthracite fell off during the summer months, and, besides, the proprietor wished to concentrate all his available strength in development work at Canmore. He opened up, however, about the first of September, and the output is now about 125 tons per day. He is putting his coal through a breaker this year and sorting it. This, owing to the friable nature of the cool, causes a large percentage of waste. He thinks he obtains a better sale and a higher price by so doing. If a cheap way could be obtained for making the dust into bricqettes, a great saving could be effected both at this point and at Canmore. Like many coals whose percentage of fixed carbon is very high, they are very friable, so that there is much loss in handling.

Alberta Railway and Coal Company's Lethbridge Colliery.—Owing to the causes referred to in my last report, the output at this point has not been nearly so great as was hoped for. However, the market for this coal south of the International Boundary has greatly improved, with a fair prospect of some further improvement in price and permanency of demand. The output is now some 800 tons per day.

Petroleum.—There was a slight excitement this year about 25 miles north of Edmonton, at Egg Lake, owing to the discovery of supposed indications of petroleum there. The substance found is of a pitchy nature, almost of the consistency of tar, and is supposed to be an indication of petroleum. It is said to resemble very much the exudations along the Athabasca and Peace Rivers, which have been thought by many who have given the subject considerable attention to indicate the existence of a large petroleum field. This discovery would seem to indicate that this petroleum field extends much farther south than has been heretofore supposed.

Natural Gas.—An attempt was made during the year to obtain natural gas at Calgary, an expenditure of $7,000 being incurred and a depth of 1,468 feet reached. The joint stock company which made this attempt was unfortunate in several ways and had to abandon operations, their drill having stuck fast and their capital being exhausted. From the experience gained, however, whoever makes the next attempt will probably be able to accomplish as much as much as has been done in this instance at about forty per cent. of the cost. It was not anticipated that gas would be obtained at a depth of less than 2,400 feet, and the company considered it would have been justified in going to a depth of at least 3,000 feet if gas were not found sooner.

Asbestos in Newfoundland.*

This peculiar and important mineral substance, which has only recently begun to attract attention in this country, has been known to exist amongst the magnesian group of rocks for a long time. It is, however, only within a year or so that the attention of capitalists from outside has been directed to Newfoundland, as likely to become a source of future supply. The province of Quebec, is at present the chief centre from whence American manufacturers of asbestos goods derive their raw material. But the comparative scarcity of the mineral, together with the increasing demand, seems to point to a possible failure of this source in the near future. It was known through the operations of Geological Survey, that extensive areas in this Island the were occupied by the magnesian group of rocks, similar in all respects to those of Canada, from whence the asbestos was obtained. This led to prospecting for the mineral with the result, that specimens showing an excellent quality of fibre, were found at several points amongst the serpentines on the west coast, chiefly in the vicinity of Port-au-Port Bay. The first attempts at actual mining, however, were only made during the past summer. A company of American capatalists having leased a mining property in the vicinity of St. George's Lake, situated between St. George's Bay and Bay of Islands, were the first to commence active operations, and it was this property which was visited during the latter part of last season. It is situated so far from the sea-board, and the difficulty and delay in getting materials wherewith to begin work on the spot caused so much delay at the outset, that little more could be accomplished last season, than a mere surface exploration over a limited area. At the time of my visit in October, all that had been accomplished consisted in an open cut of some fifty or sixty yards into the side of a low bare ridge of serpentine, and a few surface openings here and there to ascertain the strike of the serpentine belt. The open cut, however, afforded the only satisfactory exhibition of the rock and contained mineral. It consisted, at the base, of a thick mass of very loose, shaly, dark green serpentine with scaly layers and strings of very pure, amber-yellow and oil green steatite. Caught up in this shaly mass, and apparently surrounded by it a great horse or boss of hard, dark, bottle-green serpentine, presenting highly polished and fluted surfaces is seen and the whole is capped by large disconnected blocks of hard, dark-grey diorite. The mineral appeared to follow closely the outline of the harder serpentine, frequently penetrating it, but almost invariably splitting up into innumerable ribbon-like strings, which finally become mere threads. The best fibre and most persistent veins followed the outline of the harder serpentine or occupied the position between it and the overlying diorite. Where the two approached each other nearest so as to squeeze up the intervening rock appeared to be the point exhibiting the greatest amount of asbestos. One vein at such a point measured nine inches wide, consisting of several rudely parallel layers of fibre divided by thin layers of serpentine. The fibre varied in length from one half to two inches and was of fairly good quality. Specimens of beautiful fibre of about an inch long, and still others of from 2 to 3½ inches were shown me as having come from a lower part of the cut, at a place not then visible, being covered with the debris from the mine, etc. The character of the deposit, judging from what little could be seen was, as is usually the case, exceedingly irregular and confusedly jumbled up. According to the experience in Canada where asbestos mines have now been in active operation for ten or twelve years, there is apparently nothing to act as a guide in determining the value of a deposit except actual mining. No two properties present exactly the same features, and what may be found to hold good in one locality, proved entirely at fault in others, hence the difficulty in arriving at any conclusion as regards an undeveloped property, such as that descibed above. The indications are certainly good, the quality of the fibre excellent, and should the sepentine deposit in which the mineral occurs be found to occupy any considerable area there is a reasonable prospect that asbestos will accompany it. At present the situation of the mine and character of the surface deposits, renders prospecting a tedious and expensive operation. The absence of some more feasible means of getting material on the spot, was sorely felt by those in charge last year, every pound of food consumed and every item of mining tools, etc., had to be carried on men's backs from the seashore through the woods, a two days desperate drag. Few men could

be had to perform such labor, and these only at a high rate of wages. In order to facilitate the development of this and neighboring properties, I would suggest the advisability of speedily opening up communication with the sea shore by roads or other means. The Hon. P. Cleary had men at work all the summer prospecting a property of his near Bluff Head, Port-au-Port Bay, the result of which I am informed is of a very favorable character. The serpentine here is apparently more massive and forms extensive cliffs, exhibiting several small rudely parallel veins of asbestos. The fibre ranges from one quarter to about one and a half inches in length, and some of the specimens shown me from the locality were of excellent quality. Further up the coast at Lewis Brook and about two miles inland Mr. Hayes of Bay St. George holds a claim, from which a very fine sample of silky fibre about two inches long has been exhibited, but no prospecting of any consequence has taken place here as yet.

In view of the foregoing facts and the knowledge that the mineral is chiefly derived from the magnesian group of rocks, so familiarly known in Canada as Sir Wm. Logan's Quebec Group, which have been shown to occupy extensive areas in this island, both along the coast and in the interior, it is not unlikely that the next few years will witness a great amount of activity in prospecting for this substance. Newfoundland is already regarded in Canada as likely to prove "Quebec's greatest rival ere long." Should this valuable material be found in available quantity in this country, as there is every reason to expect, its development is likely to prove one of our most important and remunerative mining industries in the near future.

* From the Report of the Newfoundland Geological Survey.

The Manufacture of Peat Fuel.

In view of the papers that have from time to time appeared in the REVIEW urging the importance of the development of our great beds of peat in Ontario and Quebec for fuel, the following extracts from a report from the British Foreign Office, embodying the results of enquiries as to the manufacture of fuel, moss litter and other products from peat in Europe will be of interest :—

Denmark.—Sir H. MacDonell, Copenhagen, states that in the province of Jutland, where the peat moors extend over an area of some 90 English square miles, or one twenty-fifth of the area of the province, efforts have been made to turn this produce to profitable account. All the different modes invented during the past forty years for the treatment of peat have been tried in Denmark, and have been given up as impracticable, unprofitable, or both. Expensive experiments have been carried out at Silkeborg and Moseland within recent years, but with no appreciable results. In fact, peat may be said to be used merely for fuel, the people cutting sufficient for their own consumption. In some of the inland towns in close proximity to larger moors there still exists a certain demand for peat, but at seaports it seems never to have been able to compete with coal, the specific heating power being too low as compared with that of coal to enable the peat to pay the expenses connected with transport to any distance. Peat for fuel is either simply cut and dried, undergoing no further treatment ("Skoretorv"), or it is kneaded together and subsequently cut into regular shapes for fuel, called "Oltetorv." In this latter shape, as in the former, it does not pay the cost of transport to any distance. To the north of the Limfjord at Lundergaard Mose, the Aalborg Mosstroelsefabrik formerly employed some fifty to seventy men in cutting peat, which was used by the railway authorities for heating their carriages. This method of heating having now given place to steam, the occupation has ceased, and a moss litter factory has taken its place.

France.—From the reports received from Her Majesty's consuls, it appears that the peat industry does not exist to any appreciable extent in the consular districts of Brest and Cherbourg; a small quantity of peat is cut for the purposes of fuel, and in that of Marseilles turf is also used for burning in the neighborhood of Lyons, but there appears to be no appreciable commerce. As regards south-western France, Mr. Consul Ward reports that there are peat bogs of more or less limited extent in all the departments forming the consular district of Bordeaux, from which peat is extracted for fuel, but the production is confined to local consumption. In the district of the Charente some 7,000 tons are cut annually, but the amount is far less than in former times. But the only use to which the peat is applied on the spot is for fuel. In Paris there are four or five firms which supply peat for fuel. Under the name of "La Béraudine," a company founded by M. Béraud for working his patents and improvements in the manufacture of articles derived from peat fibre, is established at 8, Rue Saint-Martin, Paris. The company does not manufacture at present, but is about to set up a factory for utilizing the refuse for producing peat fuel or charcoal, which, it is stated, can be produced at about 50 per cent. cheaper than the "briquettes" now in use made from coaldust, &c.

Germany.—The use of peat as fuel is universal in the neighborhood of the moors, but is generally local. It cannot compete with coal for cheapness in any districts near the seaports, or near towns which have railway communication. Peat for fuel cannot pay railway freight for more than twenty miles from the place where it is cut, and very little is ever conveyed by rail. The rate charged is about 9s. per load of 9,600 sods of peat for ten miles. There are no available statistics either in Prussia or the other peat producing states as to the amount consumed, but considering the wide distribution of peat bogs throughout the country, it is probably very great. It is estimated, for instance, that in the Grand Duchy of Oldenburg alone about 150,000 tons of peat are burnt per annum, chiefly for household purposes, but also in baking-ovens, brick-kilns, &c. The following is the method of obtaining peat for fuel followed at Carolinenhorst, which may be taken as a fair example of the system generally employed. The turf is cut by gangs of four, one man cutting from the top with a sharp-cutting spade, square ended. The second cuts from the side following the first man, and at the same time dividing the turf into lengths as he goes on. This is usually done with a round-ended spade, in the shape of a turf-cutter, or whale-spade, but sometimes, though rarely, a three-sided square-ended spade is used, somewhat in the shape of a brick mould without the fourth side. The third man follows the second, and takes the sods out with a four-pronged fork, the angle of which is bent upwards to an angle of 45 degs., and lays them in rows on the moor behind the cutting. The peat is cut to a depth of 3 to 5 yards. The whole of this stratum is good with the exception of 2 or 3 in. of the upper soil, which is thrown into the cuttings already made, and yields good agricultural soil when the moor has been exhausted of peat. No machines are used on the Government moors in Pomerania for cutting fuel peat, but they have been employed on private moors where labor is scarce. The cost of production is not sensibly reduced by machine cutting. The best peat for burning is generally that which lies uppermost, the upper layer, to a depth of 4 ft. 6 in., being used (where it is of suitable quality) for moss litter; all beneath that depth for burning. At Carolinenhorst the peat is always dried in the open air, all other methods having proved too expensive. An attempt was made at Gifhorn to dry the peat artificially in an apparatus invented by Herr Rottbarth, but as the system was abandoned after a very short trial, it appears not to have been a success. The peat dries best in the spring and early summer, and when once dry it is not much injured by rain, which runs off. The drying takes on an average four months, but much of course depends upon the weather. The cutting is commenced at the end of March and continues until the middle of May—six to eight weeks. The drying lasts from the middle of May to the beginning of August—ten to twelve weeks. The stacking is carried out in the following manner :—One cubic metre of turf yields 400 sods of peat, which, as they are cut, are laid in rows as before described. Then the women employed for stacking take the wet sods from the rows and stack them in pyramids 6 ft. long by 3 ft. broad and 6 ft. high, each pyramid representing 3 cubic metres of peat, or 1,200 sods. The sods in these stacks are not laid close together, but with a space between each of the first layer, which space is covered by the succeeding layer, and so on. The peat is sold in these stacks or pyramids when dry, from the beginning of August to the middle of September, according to the weather. The pyramids are called "Klafter," and are classed for sale in the following manner :—The first class is the dark peat, approaching to coal, which is usually cut from the lowest stratum, and is heaviest. It shrinks most in the process of drying, a fresh sod when cut measuring 13 in. in length by 10 in. high and broad. This class of peat burns slowly, and when fifteen sods are burned in a closed stove they will leave about a large wineglassful of white ash. The second class is lighter in color and weight, and is a newer formation. The third class is the top stratum, and is of least value except in those cases where it is suitable for the manufacture of moss litter. These lower classes of peat leave more ash in burning. In some places these differences in the quality of peat taken from the top or the bottom of the stratum do not occur, the moss being uniform throughout.

According to the general statistics of the German Empire, fuel peat was exported from Germany as follows :—

	Tons.
1886	121,424 (includes exports to German free ports).
1887	116,713 " " " "
1888	82,300 (including 71,116 tons to free ports, and 11,184 tons to forign countries.)
1889	12,056 to foregn countries.
1890	11,819 " "
1891	11,457 " "

The greater part of this exportation goes to Switzerland from moors situated near the frontier. During the year 1891, 13,073 tons of fuel peat were imported into Germany.

Netherlands.—Black turf is almost exclusively used in the brick-kilns along the rivers Maas, Waal, Linge, Lek and Yssel. The period for digging the black turf lasts only from the 15th March to 15th June. If black turf gets frozen before having dried, it loses its heating power, and consequently its value as a merchantable article, and then it is sold at a very low price for domestic purposes. The factory turf is conveyed in barges to the brick-kilns, and here again the same difference in the cost of transport is observable in respect of the northern and southern moors, as was remarked in the case of moss litter. For instance, the freight from the north to the kilns on the Waal below Nymegen is double that from the southern provinces, but, at the same time, the competition is less keen than in the peat-moss trade, for many kilns, such as those on the Rhine and Yssel, are much nearer Groningen, Drenthe and Overyssel than North Brabant and Limburg. It is on this account that the producers of black turf in the northern and southern provinces have each their own outlets, and hence do not interfere with each other. The importance of the trade in this article may be gathered from the fact, that in the Netherlands about 7,000,000 tons (280,000 tons weight) are annually consumed in the manufacture of bricks, of a value of £133,000, of which £100,000 represent labourage and freight. The value of 1 hectare (upwards of 2 acres), good and favourably situated black peat, may safely be taken at £170.

Holland.—As regards turf for fuel, this article is produced by various means, and in very great variety of quality. The simplest form of this product is the natural turf, which has undergone no preparation, but has been cut with a spade or knife directly out of the peat, after the removal of the top layer of the so-called grey turf, in the form of a brick, dried in the air, and sold in blocks of various sizes, say, from 12 to 20 in. long, from 2 to 3 in. thick, and from 4 to 6 in. broad. This article has, in consequence of the original formation of the peat in layers, which shows itself at once when the turf is dried, all the inconvenience and undesirability of a spongy fuel, so that this natural cut turf is by no means a practical manner of preparing the peat, and is not popular as a fuel. Turf is also converted into charcoal in the same manner as wood, both in heaps and in specially constructed ovens. Turf charcoal is nearly equal to wood charcoal in heating effect, but is not so useful as the latter, as, on account of its porous nature, and proportionately large residuum of ash, the fire is less intense.

Russia.—Peat fit for fuel is found in Russia in forty-five of its provinces, on an area which, it is calculated, extends over 100,000 square versts (67,000 square miles), and is capable of yielding 875 milliards of poods (14 milliards of tons). No exact information as to the extent of the quantity of peat cut in Russia is in existence. It can only generally be said that it is found in the provinces of Moscow, Vladimir, Nijni-Novgorod, Tamboff, Orel, Kharkoff, Kieff, Esthonia, and St. Petersburg, where it is prepared as fuel for manufactories, sugar works, and other industrial establishments, as also for locomotives. Among the peat bogs which belong to the Crown, those lying in the provinces of St. Petersburg, Moscow, Orel, Riazan, Vladimir, Tamboff, and along the Kursk-Kieff line have been surveyed. The result of this survey proves that the peat bogs of the Crown in the above localities contain no less than 100 millions of cubic feet of peat of excellent quality. Some of these peat bogs are leased under the Crown by private individuals.

Sweden and Norway.—In the west, south, and south-east parts of this district, peat, as fuel for domestic purposes, has been extensively in use for the last century, and even earlier, as by degrees the forests have diminished, or become of too great value for like purposes. It is a bulky kind of fuel, but an excellent substitute where wood is scare or unobtainable. For industrial purposes peat is not yet used on any extensive scale; some glass-works, however, having large tracts of peat in their immediate neighborhood, have found it to their advantage to work the peat, and usually employ machinery of German construction for raising and shaping the material into a form of less bulk. Mixed with small coal, it makes an excellent fuel. Also some ironworks use peat, but not largely; it is, of course, unmixed, and only used for certain purposes, owing to its purity. A scheme of condensing peat into the shape of a coal is being tried, but as yet the undertaking is not sufficiently developed to judge whether it will prove a success or not. The peat bogs of Sweden cover an immense surface, amounting to many millions of acres, nor are they confined to any one part of the Kingdom, though the largest of them are either in the extreme northern provinces, or in the provinces of Dalecarlia, Vermland, Smaland, Halland, and North Scania. In Upper Noorland and in Lapland there are peat bogs hundreds of square miles in size, and consisting of turf of excellent quality; in other provinces the bogs have turf of different qualities, and occasionally different qualities of turf are met with in one and the same bog. The depth of the turf varies from 3 ft. to 37 ft., and even more. It is an old custom in the southern provinces to burn turf as fuel in private dwellings; especially is this the case in the provinces along the coast, where there is no wood to spare for burning. There are numerous ways of treating the turf (when cut) by machinery. There are different machines for disintegrating, rolling, and pressing it, and making it hard after drying. The actual drying generally takes place on a flattened-out piece of the bog itself, either by spreading it out or putting it up on frames. Besides the above air-drying of the turf, several ironworks have of late years established ovens of various sorts for the further dissection of the turf. These ovens have in general given very good results. They are heated by the surplus heat of the furnaces, which thus costs nothing, and yet the turf gains from 25 to 30 per cent. in value from the process. The ordinary turf for burning in dwelling-houses in the southern provinces, where wood is scarce, is chiefly cut brick-shape, by spades made for the purpose, and then dried at the place where it is cut, by simply spreading it out in small heaps. It costs very little to cut, but is rather loose, owing to its being treated in so primitive a fashion. Such turf as is intended for industrial purposes is always worked up or disintegrated in one way or another, so as to be hard and solid when dried, and thus give more heat when burnt. At ironworks, turf is used in the furnaces either by itself or else mixed with coal and fir cones. At wood-pulp factories it is used for drying the pulp. Turf is also burnt in glassworks, brickworks, and as fuel for steam engines, &c. It is only in the south of Sweden, and even there in but few cases, that there are factories for the preparation of turf for sale as fuel. It is impossible to give any exact figures as to the amount of prepared turf yearly produced in Sweden for burning, as no figures are recorded. Its use is increasing year by year, owing to its being a cheaper fuel than coal. About 25,000 to 30,000 tons a year may be said to be employed

in metallurgic works of different kinds. The cost of producing well-made turf for fuel may be given as from 4s. 4d. to 5s. 5d. per ton, according to the price of labor in different places. Good turf for fuel is expected to contain from 30 to 40 per cent. of heating material, and not above 7 to 10 per cent. of ash, and there is an enormous quantity of such turf in Sweden.

Natural Gas.*

The various theories concerning the origin of oil and gas may be divided into two classes—one assisting the chemical reactions of minerals or inorganic matter, and those claiming an organic origin through the decomposition of vegetable or animal matter. According to the theory of the former, petroleum and marsh gas are formed by the action of water, carrying carbonic acid in solution, upon alkali metals existing in a free state and at a high temperature in the centre of the earth; and they point the reactions that would take place, resulting in the formation of hydrocarbon compounds.

This theory considers the production of the liquid and gaseous hydrocarbons as continuous, the vapours rising as they are formed, the condensible portion forming petroleum and both the condensible and incondensible being retained in the porous strata in which they are now found. This theory would make the supply of these products inexhaustible as long as the necessary minerals and water exist, but the theory, though chemically perfect, is not generally accepted by geologists, since it does not accord with geological facts, which point more to the organic origin of gas and oil—that is, to their derivation from the decomposition of vegetable or animal matter originally contained in the rocks in which they are found, or in closely associated strata. Peat bogs yield inflammable gases, and sometimes also members of the bitumen series closely allied to petroleum, proving the decomposition of vegetable matter to be competent to produce natural gas and petroleum. While geologists are pretty well agreed as to the source from which gas and oil are derived, they differ somewhat as to the process of production. There is the distillation theory and the theory of primary decomposition. I shall cite Mr. S. F. Peckham as the exponent of the distillation theory. In his report on petroleum contained in 10th volume of the Special Reports of the United States Census of 1880, he states he considers petroleum was formed by distillation principally from beds of shale, fucoid plants, and animal remains, with limestone as a minor source, basing this view upon the variations in composition of petroleum found in different portions of the same field, which, he thinks, can only be accounted for on the theory of fractional distillation. In Pennsylvania, he says, gas and oil are derived from vegetable remains in rocks far below the present level of the strata in which they are found, the heat for their distillation being supplied by the causes that resulted in the upheaval of the Appalachian mountain system, the evidences of this heat are to be found deep down beneath the unaltered rocks in which gas and oil are now stored.

As an argument against the theory of distillation, Prof. Orton cites the fact that the study of the rocks underlying the Ohio gas and oil fields, as shown by means of boring, carried 1,800 ft. below the oil-bearing strata, shows no signs of metamorphism, which at this depth is below the only known sources of oil supply of the Pennsylvania type, and would seem to condemn the idea of distillation. In favor of the theory of primary distillation he notes the fact that at the present day in Trinidad, beds of slate formed in comparatively recent times beneath the sea, but now raised above its level and containing abundant vegetable remains, are yielding petroleum in large quantities by direct decomposition of vegetable tissues, this petroleum passing into asphalt as a result of exposure to the atmosphere. If the action took place when the petroleum could be stored out of contact with the air, it would remain as petroleum. This he considers is what has happened in the oil fields. Professor Orton's theory is that these oil fields were the site of a tropical sea, upon the floor of which the shales constituting the chief source of the oil were accumulated. The rivers emptying into the sea laid down sedimentary deposits of clay and sand with occasional gravel bars. In the sea itself was a vast development of marine vegetation. Some of the especially abundant plants had very resinous spores and spore cases, which were set free in enormous quantities, and in connection with other portions of these and similar plants were carried to the bottom in a macerated condition, there to pass through the coaly transformations resulting in the structureless carbonaceous matter that constantly characterises black shales. The shales, thus slowly accumulated at the bottom of the gulf, must have behaved as similar shales do now, petroleum, marsh gas and bitumen being formed. This process continued until the materials were exhausted, producing a shale much richer in petroleum than any portion of it is at the present day. On this shale formation was laid a bed of porous sandstone saturated with sea water and roofed in by a very fine grained shale. Then by a gradual exchange between sandstone and shale the gas and oil reached their final reservoirs. I have thus given somewhat in detail the two most prominent theories in regard to the production of petroleum and natural gas. Both theories assume that a shale containing the remains of plants and animals is the source from which they are derived. It seems to me the term "A slow system of exchange" simply means a slow system of decomposition or distillation, and therefore differs from the other only in degree. Probably both causes have been at work to produce the different results found in different fields. After further discussing geological features at some length, Mr. Young proceeded to speak of the chemical constituents of gas, and then passed on to the more practical phase of the question, the consumption of gas, dealing particularly with domestic uses. Natural gas is generally rated at 1,000 heat units per foot The combustion of 1 cubic foot will raise the temperature of 1,000 lbs. of water 1 deg. provided all the heat the gas generates is absorbed by the water. This, however, can only be accomplished by carefully constructed appliances. In ordinary use not more than from 50 to 70 per cent. of the heat generated is utilized. One cubic foot of gas will also raise the temperature of 48,000 cubic feet of air 1 deg. if the heat generated is all absorbed by the air; therefore to raise the temperature of 48,000 cubic feet of air from zero to 70 degs. requires the consumption of 70 cubic feet of gas, and to raise it from 35 degs. to 70 degs. requires 35 feet of gas, consequently it will require double the quantity of gas to raise the temperature in a building to 70 degs. when the outside temperature is zero that it does to raise it to 70 degs. when the outside temperature is 35 degs. In actual practice it takes more than double quantity between these two points, as the greater the difference there is between the inside and outside temperatures the greater the inrush of cold air into the house and the greater the cooling effect of windows, &c. People often seem to forget this fact, but it is never overlooked by the silent recorder in the cellar, and when the bill comes in they open their eyes in amazement and immediately conclude the meter is a fraud and gas companies robbers of the worst description.

If we could only manage to utilize all the heat generated by the gas a comparatively small quantity would be required to heat our houses, but unfortunately, in the majority of appliances used for burning gas a large percentage of the heat is carried up the chimney, and it is more difficult to overcome this loss than might be supposed. For instance, in a furnace we have, which contains 95 square feet of absorbing and radiating surface, I find that with the volume of cold air passing into the furnace supplying three registers, and at a temperature of 30 degs., I cannot burn more than 30 ft. of gas per hour and keep the products of combustion down to a temperature of 150 degs. You can easily see what a large percentage of the heat would be lost if the products of combustion from the 30 ft. of gas went directly into the chimney instead of being drawn off by the radiators and passed on to the registers. In very few appliances for fire-places are there any radiators, and the products of combustion pass directly from the burner to the chimney. A large amount of water is formed in the combustion of natural gas, and if the products of combustion are too much cooled down the water vapor condenses and causes trouble. The products of combustion must be carried off at a temperature high enough to prevent condensation or else an excess of air must be admitted in order to absorb and carry off the moisture; in either case considerable loss of heat ensues. Of course it is possible to utilize all the heat generated if the products of combustion are allowed to pass into the room, but this is not only injurious to health, but under certain circumstances may prove fatal. Natural gas contains about 75 per cent. by weight of carbon, and the product of its combustion is always carbonic acid gas, at least 1 ft. of CO_2 for every foot of gas used. I have stated that water is always produced in the combustion of natural gas. It is produced by the union of the hydrogen of the gas with the oxygen of the atmosphere.

According to the last census report the average daily consumption of natural gas in the United States in 1889 was over 1,500,000,000 cubic feet. Taking 25 per cent. as the average proportion of hydrogen in the gas, the quantity of water produced daily would be 15,344,235 gallons.

The quantity of carbon carried daily through the pipes equals 24,454 tons. It is estimated that in 1889 natural gas displaced an amount of coal valued at $21,097,099. From this will be seen the immense proportions the use of natural gas has assumed within the past ten years. Before restrictive measures were fairly in operation the gas fields from which the gas was drawn had become so much exhausted that it was found necessary to largely cut down the use of gas for manufacturing purposes, and about two years ago it looked as if the supply would soon be at an end. However, new fields have been discovered and the gas companies have the drill constantly at work with the object of maintaining the supply. While it is not probable that in the future, in this vicinity gas will be found in sufficient quantity to justify its use to any great extent for manufacturing purposes, I think that with the economy now practised in its use we may have sufficient gas for domestic use for some years yet; however, the day may come when the supply of the natural article will be completely exhausted.

* Abstract of an introductory lecture delivered before the Western University of Pennsylvania by John Young, Superintendent Allegheny Heating Company.

From Mine to Furnace.*

By John Birkinbine, President of the American Institute of Mining Engineers.

The mining or quarrying of iron ores, coal and limestone, from the earth; their preparation, handling transportation, and the smelting of the ores into pig iron, offer the theme for what could be made an instructive story, increasing in interest as we take into consideration the earlier history of coal and ore mining and iron production, and as we note the improvement made in processes, and the advances in quantity and quality produced.

The story of iron production and manufacture is old. You have been told of Tubal Cain in the seventh generation from Adam, being "an instructor of every artificer in iron," and of the use of this metal in the pyramids of Egypt, and in the gates of the city of Babylon, of the ancient book of Job mentioning "bars of iron," "barbed irons," etc. This iron was probably made in the simplest possible manner, the ore being taken from the ground, and converted into wrought iron, with the aid of wood or charcoal in heaps in pits, or in crude furnaces. But we need not go far back to trace developments, for the past half century, or even the last twenty years, show more advancement in this specialty than all the preceding years since iron was first mentioned as a metal. I shall say little concerning iron as a metal, preferring to make this a connecting link between two lectures which I presented in this room, viz: "The Iron Ores of the United States" (delivered five years ago), and "The Development of the Pig Iron Manufacture in the United States," delivered in February, 1891. The substance of neither of these will be repeated, except to call attention to subsequent developments, and to mention facts necessary to bring these two lectures into a connected story.

I shall not, therefore, consider the mining of ores other than those of iron, nor the production of any metal except the necessary incidental reference to pig iron.

To smelt iron ores a fuel and flux are necessary, and in this country four fuels are employed, namely, anthracite coal, bituminous coal, coke made from bituminous coal, and charcoal. Coke is by far the most in demand for this purpose, and raw bituminous coal is used to but a limited extent, no record being now kept of the comparatively small portion of pig iron made with it exclusively. Including the output of furnaces using raw bituminous coal, alone, or mixed with coke, with those employing coke alone for this purpose, we find that of all the pig iron produced in the United States, 70·6 per cent. is smelted with coke and bituminous coal.

Coke is also liberally used with anthracite coal in varied proportions in the eastern part of the United States, 18·8 per cent. of the pig iron being made with these mixed fuels, and but 3·7 per cent. of our pig iron output being smelted with anthracite coal alone; the remainder, 6·9 per cent., is produced by the use of charcoal. At present the relative employment of the different fuels rank in the following order:

Coke, sometimes mixed with raw bituminous coal.
Anthracite and coke mixed.
Charcoal.
Anthracite alone.
Raw bituminous coal.

Limestone is the universal flux used, although different conditions require stone of varying composition, from nearly pure carbonate of lime to a mixture of the carbonates of lime and magnesia, known as dolomite.

The iron ores fed to blast furnaces are also of varying composition; the convenience of these to furnaces, the yield of iron, the proportion of other ingredients which they carry, such as silica, lime, alumina, magnesia, phosphorus, sulphur, titanium, manganese, etc., and the expense of mining the ores influencing their use.

It is not within the province of this lecture to discuss the chemical composition of ores, but as the methods of producing different varieties, and the yield of these in iron will necessarily demand attention, a brief summary of the classification adopted is offered.

The iron ores produced in the United States may be divided into four general classes, without particular reference to their geological occurrence, but approaching within narrow limits the practice generally followed in the sale and purchase of iron ores.

(1) *Red Hematite*, all the anhydrous oxides of iron known by various names, such as red hematite, blue hematite, specular, micaceous, fossil, slate iron, martite, flax-seed ore, etc.

(2) *Brown Hematite*, including the varieties of hydrated sesquioxide of iron, variously known as limonite, gœthite, turgite, bog ore, pipe ore, pond ore, grape ore, and also some manganiferous iron ore, and most of the iron ores mined in the Rocky Mountain region for the smelting of argentiferous ores.

(3) *Magnetite*, those ores in which the iron is found chiefly as magnetic oxide; this class also includes some martite mined with the magnetite.

(4) *Carbonates*, those ores which contain a considerable amount of carbonic acid, such as spathic ore, siderite, black hand, clay ironstone, etc.

Coal.—The universal use of coal makes the quantity employed for producing pig iron, though aggregating millions of tons, represent but a small percentage of the total output, hence a few facts only need be given of the production, preparation, handling, or utilization of coal. A review of the methods employed in various parts of the country would make a lecture of itself.

Great Britain and the United States are the two principal coal producing countries in the world, followed by Germany, France, Austria, Belgium, Russia, Australasia, Canada, Japan, India and Spain, in the order named; these being the only countries which up to date have records of a yearly output of over 1,000,000 tons each.

The United States, occupying second position, produced in the year 1891, 150,500,000 tons of coal, or

* A lecture delivered before the Franklin Institute, November 14th, 1892.

thirty per cent. of the total coal production of the world, variously estimated as from 500,000,000 to 550,000,000 tons in 1891.

In 1891, Great Britain produced 185,500,000 tons or 30,000,000 tons more than the United States. If, however, a retrospective view of the increase in the coal production in these two countries be taken, it will show that Great Britain's output since 1880 has augmented 38,500,000 tons, while that of the United States, in the same period, shows an increase of 87,000,000 tons, and if this rate be maintained, it is probable that in the near future, the output of the United States will surpass that of Great Britain.

Of the other countries, Germany produced in 1891 94,000,000 tons (of which, approximately, one-fifth was lignite); France and Austria 26,000,000 each—two-thirds of Austria's product being lignite; and Belgium 20,000,000 tons. None of the other countries have yet reached a yearly output of 10,000,000 tons.

In coal mining, Pennsylvania occupies first place among the thirty-one States and Territories (including Alaska), which produced this fuel. According to the census of 1889, it contributed fifty-eight per cent. of the nation's coal output, and more than one-half of what was credited to this State came from the anthracite coal fields of Eastern Pennsylvania.

As coal is used for so many other purposes, the consumption of this fuel in the production of pig iron can be only approximated. An estimate carefully prepared places the consumption in our blast furnaces in 1891 at 2,000,000 tons of anthracite coal, 12,000,000 tons of bituminous coal, principally converted into coke, and 66,000,000 bushels of charcoal.

It should be borne in mind that when referring later to iron ores, the amounts mentioned are of prepared ore ready for shipment, for the actual exploitation of the various mines demands a removal of quantities much in excess of those given. The brown hematites, as a rule, are washed to remove clay and foreign matter, and to enrich the ore, and often the amount of such foreign matter removed is four or more times as great as that retained. The carbonate ores must be roasted to remove their carbonic acid, and the roasted ores represent only about half the weight of the raw ores. Roasting is also applied to sulphurous ores, and hand sorting is applied liberally employed in the Lake Superior region. In addition to this the separation of comminuted ore, either by jigs or by magnetism, produces a ton of concentrated ore from one and one-half to five tons of crude material. It is therefore probable that for the production of over 14,500,000 tons of merchantable ore in 1891, fully 25,000,000 tons of material were removed from the ground.

The quantity of limestone used as a flux for blast furnaces in 1890, as reported to the United States Geological Survey, was approximately 5,500,000 tons, and in 1891 the amount thus used would be about 5,000,000 tons. We therefore have in round numbers 35,500,000 tons of raw material, mined or quarried, and prepared for market, to produce 8,250,000 tons of pig iron, nearly all of which has to be carried a considerable distance to points of consumption. If we allow for unmerchantable material mined and handled, it is probable that we would reach a total exceeding 50,000,000 gross tons annually. No attempt will be made to discuss the amount of labor required to produce, prepare, handle and transport this raw material. A statement of the quantity required is sufficient for present purposes, but some of the features connected with the handling and transportation of these materials will be offered.

Iron Ores—The United States is at present the largest iron ore producing country in the world, her 1891 output of 14,500,000 gross tons being 1,750,000 tons more than her nearest rival, Great Britain, supplied in that year. Great Britain has in a former year, 1880, produced 18,000,000 tons, while the largest output of the United States was in 1890, when 16,000,000 tons were produced. Great Britain has, however, shown a great falling off in the output of her domestic iron ore mines, while her imports of foreign ores have been growing larger.

Of the other large iron ore producing countries, Germany contributed in 1891 over 10,500,000 tons, Spain approximated 5,000,000 tons, France 3,500,000 tons, Austria and Hungary over 2,000,000 tons, Russia 1,750,000 tons, and Sweden not quite 1,000,000 tons. Iron ores are also largely mined in Algeria, Italy (principally in the island of Elba), Greece, Cuba, China, and in smaller amounts in various other foreign countries.

Great Britain and the United States combined produce fully one-half of the iron ore mined in the world.

In the year 1887, when the lecture on iron ore was presented, this country was estimated as producing nearly 12,000,000 tons of iron ore; in 1890, the output of our domestic mines, as above stated, was over 16,000,000 tons; and although there was a marked decline in iron production and allied industries last year, the mining of over 14,500,000 tons of iron ore in 1891 shows an increase in five years of over twenty per cent.

There are no authentic records of the output of the different kinds of iron ores in the various States in 1887, or, in fact, for any years except 1880, 1889, 1890 and 1891, the first two being Census figures, while the last two were prepared for the division of mineral statistics and technology of the United States Geological Survey.

[The lecturer here exhibited a diagram, showing the amounts of the different kinds of iron ore produced in the various States in the four years above-mentioned. Only those States which mined over 100,000 tons of iron ore were shown, the smaller producers being grouped together under the head of "other States." Solid cross-section lines, indicated red hematite ores; dotted cross-section lines, brown hematite ores; black blocks, magnetite, and dotted blocks, carbonate ores. The States were placed in the order of their precedence as total producers in the different years, *i.e.*, the State holding first rank was placed at the bottom of the column, and the second immediately above it, etc. The same scale was used in each of the columns, and the same tonnage in one year occupied equal spaces in any of the other years.]

The diagram shows a decided advance in the use of hematites, a slight decline in the proportionate amount of magnetites, and a very great falling off in the quantity of carbonates used in the decade.

In the year 1880, thirty-one and one-half per cent. of the total iron ore product of the country was red hematite; in 1889, it had risen to sixty-two ond one-third; in 1890, to sixty-five and two-thirds per cent., falling off slightly in 1891, when the percentage of the total was but sixty-four.

The brown hematites constituted twenty-seven per cent. of the total iron ore mined in the United States in 1880, the proportion declining in 1889 to seventeen and one-third per cent., and in 1890 to only sixteen per cent., but advancing in 1891 to nineteen per cent. of the total.

Thirty per cent. of the country's iron ore output in 1880 was of the magnetite variety; but in 1889, less than seventeen and one-third per cent.; in 1890, sixteen per cent., and in 1891, less than sixteen per cent. of the total was of this character of iron ore.

The percentages of carbonate ore used shows a constant decline from eleven and one-half per cent. in 1880 to three per cent. in 1889, two and one-third per cent. in 1890, and one and one-third per cent. of the total product for the country in 1891.

While the above indicates a decline in the proportion of all the ores used except red hematite, a comparison of the outputs for 1880 and 1891 shows a material decrease in quantity in carbonates only; the magnetites and hematites having an augmented production.

The amounts of the different kinds of iron ore produced in 1891 were as follows: 9,327,398 tons of red hematite, 2,757,564 gross tons of brown hematite, 2,317,108 gross tons of magnetite, and 189,108 tons of carbonate ore, making a total iron ore product for the year of 14,591,178 gross tons. Of this total, Michigan contributed over 6,000,000 tons; Alabama nearly 2,000,000; Pennsylvania over 1,250,000; New York, 1,000,000, and Minnesota nearly 1,000,000 tons; the total of these five States aggregating nearly 11,500,000 tons, or nearly seventy-eight per cent. of the country's output of domestic ores for 1891. This total will exceed 11,500,000 tons by adding scattered operations from which no returns were received. In addition to the American ores mined, nearly 1,000,000 tons of foreign iron ores were imported into the country. There was also considerable amounts of mill cinder, blue billy, franklinite slag, etc., used; but in tracing the ore from mine to furnace, these may be considered as being offset by the amount of iron ore which is used as flux in puddling and heating furnaces, as flux in silver smelting, and in the manufacture of paint, etc.

The relative rank of States as producers in the various years offers interesting suggestions as to the changes in their percentages of the iron ore output, and in the table below is given the total output of iron ores in 1880, 1889, 1890 and 1891, with the percentages of this total which each State produced:

	1880 Per Ct.	1889 Per Ct.	1890 Per Ct.	1891 Per Ct.
Pennsylvania.	27·41	10·75	8·50	8·72
New Jersey..	9·50	2·86	3·09	3·60
New York...	15·83	8·59	7·82	6·97
Michigan....	23·04	40·34	44·54	41·99
Wisconsin...	0·52	5·77	5·92	4·04
Minnesota...	—	5·95	5·56	6·48
Alabama.....	2·40	10·82	11·83	13·62
Virginia.....	2·29	3·43	3·39	4·52
Tennessee...	1·31	3·26	2·90	3·73
Georgia.....	1·15	1·71	1·52	1·72
Missouri.....	4·84	1·83	1·13	0·73
Colorado....	—	0·75	0·71	0·76
Total output in gross tons,	7,120,362	14,518,041	16,036,043	14,591,178

All of the iron ore obtained from Minnesota in 1891, over seven-eighths of that from Michigan, nine-tenths of that from Wisconsin, three-fourths of that from Alabama and Tennessee, and nearly all of that from Missouri, was of the red hematite variety. Virginia is the largest producer of brown hematites (nearly all of its product being of that character of ore), followed in order by Alabama, Michigan, Pennsylvania, Georgia and Tennessee, as important contributors, and this is the only class of ore mined in the New England States, Texas, Oregon and some other States. Three-fourths of the total output of New York, over one-half the Pennsylvania product, and practically all of that obtained from New Jersey was magnetite, these three States producing seven-eighths of the total of this character of ore mined. Michigan follows New Jersey, then follow New Mexico and North Carolina as producers of magnetite. The State of Ohio was the only large producer of carbonate ore in 1891, although smaller amounts were obtained in New York, Pennsylvania, Kentucky and Maryland.

The product according to States does not properly represent the development of the iron ore industry, as well as that of certain prominent districts, and a diagram is presented to show the authentic record of such of the more prominent districts as could be obtained for twenty years past, or less. The rapid advance of the Lake Superior districts illustrates the growing favor of the blast furnace managers to the use of the rich red hematite ores. The combined lake and all rail shipments of the four districts will, in 1892, slightly exceed those of 1890. In this representation the importations of foreign ores (ninety-five per cent. of which were received at the ports of Philadelphia and Baltimore) were inserted for the purpose of comparison.

Even the products by districts does not truly show the remarkable extent which the development has reached in certain localities for nine mines in the Marquette Range, three in the Menominee, four in the Gogebic Range, and two in the Vermilion Range, have since their opening contributed from 1,000,000 to 6,000,000 tons each. The mines at Port Henry, N.Y., have yielded to date about 10,500,000 tons of iron ore, but no single deposit has equalled the record of the Cornwall ore hills in Pennsylvania, exceeding 12,000,000 tons, which have been obtained from this deposit, which has for a number of years averaged a greater output per annum than any other single mining enterprise, reaching its maximum of 769,000 tons in 1889. On three occasions, however, this maximum has been exceeded by the annual output of one of the Lake Superior mining companies.*

In the year 1891 there were but four mining enterprises in the country, the product of which exceeded 500,000 tons, although an equal number closely approximated this output. Two of these four great producers were located in Michigan, one in Minnesota and one in Pennsylvania. In addition there were in the Marquette Range three, in the Gogebic Range two, in the Menominee Range one, in Minnesota one, in New York two, and in Alabama three mining operations whose output in 1891 was between 200,000 and 500,000 tons.

Although iron ore in this country was first fonnd in North Carolina, and iron was first produced in Virginia, the successful pioneer enterprise was in Massachusetts, in the year 1645, Most of the ore used was bog or pond ore, and one plant in Canada, is still operated chiefly on this class of brown hematite ore. The following illustrates the way in which pond ores were obtained in Massachusetts in the year 1794:† "Vast quantities of iron, both cast and wrought, have been made in this part of the country for more than a hundred years past; but it was chiefly out of bog ore, until that kind was much exhausted in these parts. About the year 1747 it was discovered that there was an iron mine in the bottom of our great pond at Assowamset; and after some years it became the main ore that was used in the town, both at furnaces and forges, and much of it has been carried into the neighboring places for the same purpose. Men go out with boats, and make use of instruments much like those with which oysters are taken, to get up the ore from the bottom of the pond. I am told that for a number of years a man would take up and bring to shore two tons of it in a day, but now it is so much exhausted that half a ton is reckoned a good day's work for one man. But in an adjacent pond it is now plenty, where the water is twenty feet deep, and much is taken from that depth, as well as from shoaler water. It has also been plenty in a pond in the town of Carver, where they have a furnace upon the stream which runs from it. The quantity of this treasure, which hath been taken out of the bottom of clear ponds, is said to have been sometimes as much as 500 tons in a year." The average price of these pond ores was about $6 per ton, delivered at the furnace.

Nearly all of the iron ore mined in the earlier history of the iron industry was of the bog or pond varieties, and it was not until the commencement of the eighteenth century that any of the magnetic ores of New Jersey were utilized. The Dickerson mine, which lately closed down, was one of the first mines of this character of ore opened, being located in 1716. The ore was often carried to the iron works in leather bags on pack horses.

Blast furnaces increasing in number and size required larger supplies of iron ore, flux and fuel, and to meet this it was necessary to employ other methods than those of dragging for iron. At first most of the mines were worked "open cut," but as the demands increased it became necessary to work underground so as to avoid heavy stripping, and danger from slides. There are, however, numerous open cut mines wrought at present and some large underground operations are being transformed into open cuts. The pick and the shovel, while still used, are largely supplemented by the steam, air or electric drills, and in some cases by steam shovels. High explosives have displaced much of the ordinary powder. and the wagons or carts drawn to the surface by horses or mules are to a great extent superseded by hoisting appliances operated by steam power or by compressed air, and in place of ore carried in wagons or on pack saddles, we have the rapid and cheap transportation by the various steam railroads to supplement that by water. The harder red specular ores, which were first mined in Michigan in 1847, owing to low water transportation rates and the high percentage of iron they contain, came rapidly into favor and it may be of interest to draw a comparison between the pond ore exploitation described above and onc of the modern iron ore mines of the Lake Superior district.

At the Chapin mine at Iron Mountain, Mich., the ore is taken from four shafts, ranging from 300 to over 600 feet in depth, and from an open pit of over an acre in area. The fourth shaft was sunk through a stratum of quicksand, and in order to pass this, a circle of iron pipes was driven and connected with a refrigerating machine. This reduced the temperature of the contents

* In 1892 three mining operations exceeded the output of the Cornwall ore hills.

† Vide Volume of Manufactures; Tenth Census, p. 798.

of the pipe to about zero, freezing the quicksand, and, keeping it frozen, this was then drilled and blasted like rock. The machinery of the mine is run chiefly by means of compressed air, although there is ample boiler capacity to operate the entire plant in case of accident to the compressor plant. This compressed air is carried a distance of three miles in wrought-iron pipe 24 inches in diameter. The Quinnesec Falls furnish, under a head of about 52 feet, the water to three 48 inch and one 54-inch turbines. There are three pairs of 32-inch diameter and 60-inch stroke, and one pair of 36-inch diameter and 60-inch stroke compressors. This compressed air is the motive power for the hoisting plant and also for more than 100 power drills. The number of employes varies from 1,800 to nearly 2,000. The ore is found in four large lenses, and is broken down by means of power drills and high explosives, loaded on mine cars, taken to the shafts, hoisted to the surface, where a cable conveys it to the trestle, on which the cars are automatically dumped into railroad cars or taken to the stock pile, from which the ore is afterward loaded on railroad cars by means of a steam shovel. By this means a twenty-ton car has been loaded in four minutes. As much as 2,700 tons of ore have been hoisted from one shaft in twenty-four hours, and in one year over 700,000 tons were mined.

While it would be interesting to follow the details of some of the special features of the great producers, it is not practicable in the limited time to do more than call attention to some typical illustrations of mines of different character, or the means employed for their exploitation, and the instances have been selected more with the object of exhibiting prominent features, than as an attempt to cover various details of operation. They are offered to illustrate the peculiarities of mining the different characters of iron ore in various sections of the country.*

During the present year considerable interest has been attracted to the apparently large deposits of iron ore of a satisfactory character, which can be easily mined from what is known as the Mesabi range, in Minnesota, and this locality is now passing through the developing stages which have characterized the earlier history of other sections in the Lake Superior regions, which have become producers of iron ore.

The pioneers penetrate the forest, generally "packing" their provisions and tools with them, erect a log cabin, and start the preliminary operations with pick, shovel and hand drill, supplemented by hand winch, bucket and pump. If an apparently satisfactory deposit is found, machinery soon takes the place of manual labor, and compressed air is early applied to these enterprises. The necessity of labor saving appliances demands the prompt application of such economies, and not only are power drills introduced in the early history of most of the mines, but diamond drills are among the implements which may be found at work in the heart of a forest or in the midst of swamps seeking to discover the subterranean secrets. In fact, one who has never visited a newly developing iron region, would be surprised to note how quickly the economies of exploring or exploiting mines, and for transporting the material from them are introduced.

Interesting lessons can be learned by visits to mines in different sections of the country, which are operated to produce the various classes of iron ores. The red hematite mines of the Minnesota Iron Company in Minnesota, the Norrie mine, the Ashland, the Colby, of the Gogebic range; the Lake Superior, the Cleveland, the Champion, the Ludington, the Florence and the Penn Iron Mining Company, in the Menominee range, each possess some quality of interest to the investigator, either by the depth to which the deposit is wrought, sometimes to 1,300 feet; the extent of the underground drifts, the occurrence of ore in the lenses, and in some cases the admixture of magnetite and hematite, all offering interesting themes for study. The Nevada system of timbering, which is liberally employed in the Lake Superior mines, is also in strong contrast with the solid ore columns, 300 feet high, supporting the roof at the magnetite mines at Port Henry, N.Y., and similar though shorter columns at Lyon Mountain, N.Y., and other magnetic mines.

More contrasts are found in the open cut and underground work in different localities; the Tilly Foster mine of magnetite in New York State has become renowned for the efforts there made to secure its dangerous walls, commencing with great arches of brick, sustaining massive braces of concrete, which were placed in rooms which had been worked out, so as to permit removal of pillars, and ending with the blasting away of 500,000 tons of hanging-wall rock, so as to make the work an open cut. On the other hand, the Iron Mountain, Mo., originally wrought as an open cut, is principally exploited by underground workings to remove a mass of detrital ore from the original deposits which had been subsequently covered by rock of later deposition. The Cornwall ore hills have been wrought open cut until over 12,000,000 tons have been removed from them, an amount nearly four times as great as that won from Iron Mountain, Mo., and there are to-day magnificent faces of this soft magnetite exposed in the hills and railroad cuts passing through the Cornwall property. The mining of the carbonate ore deposits near the Hudson River, N.Y., the winning of the fossil ores in Nothern New York, the stripping of sand from the bog deposits of Texas, the handling of the brown hematites of Alabama, Tennessee and other States by steam shovels, all add to the variety of methods and appliances used.

Transportation of Iron Ores and Coal.—Much of the iron ore from the Lake Superior region, from New York, and some from other States, also large quantities of coal, have to be transported long distances to reach points of consumption, and reshipment is necessary where the transportations are made by both rail and water. An essential of such rehandling and transporting is that it should be done in the least possible time and at small expense, in order to enable the ores to compete with others, which, although not so rich, are found nearer the blast furnaces. As the principal cost of rehandling is for labor, large amounts of money have been expended by different iron and railroad companies for docks and cars built specially for the purpose, so as to bring this item to the lowest point practicable, and also make it possible to handle greater quantities of material than by manual labor. It is now no unusual thing for ore to be taken from the mine in "skips," automatically dumped into specially constructed railroad cars or into ore bins from which it can be discharged into cars, then hauled in these cars to ore docks, where the drop bottoms of the cars are opened and the ore falls into pockets, from which it is run into the hold of the vessel, and in this whole process the only labor necessary is to open the doors of the bins or the bottoms of the railroad cars.

The ore shipping docks on Lakes Superior and Michigan (the largest in the country, if not in the world), in connection with the ore receiving docks at the lower lake ports (fitted with bridge tramway plants), the railroad cars, and in some cases vessels specially constructed for this purpose, have aided materially in reducing the cost of transporting iron ore to points of consumption. The furnace manager, by means of advanced methods, cheaper or richer iron ores, improved facilities, and larger output, has lessened the cost of pig iron, which in turn has lowered the price of manufactured iron and steel, which has been one of the most important, if not the most important factor in bringing this country up to its present degree of prosperity.

In addition to the seventeen shipping docks erected to handle iron ores from the Lake Superior region, there are others of less magnitude on Lake Champlain, on the Mississippi River, and elsewhere, but the proportions of the docks on Lake Superior and Michigan and the quantities of ore handled by them are much greater than the others, and the same holds true concerning the ore-receiving docks at lower lake ports, for from this region was obtained 52 per cent. of all the iron ore mined in the United States in 1891.

The ore shipping docks consist of a wooden structure, built on piles. The top of the dock is from 38 feet to 51 feet 10 inches above the ordinary water level and wide enough to accommodate from two to five lines of railroad tracks. The ore docks have from fifty to 300 pockets, holding from 80 to 170 tons of ore each. The pockets are sheathed with plate iron and slope downward toward the water side of the dock. At the bottom of each pocket is a door which is controlled from the top of the dock. When it is desired to load a vessel, plate iron chutes, usually semi-circular in form, are lowered into the hatches of the boat, the doors which connect these chutes to the respective pocket are raised, and the ore discharges itself into the hold of the vessel.

Marquette, Mich., is the port from which the first Lake Superior iron ore was sent, and up to the close of the year 1891 there have been loaded into vessels 17,616,880 tons at this port, which in 1891 ranked third, with a shipment of 1,056,027 long tons, all from the Marquette range.

In 1865, Escanaba, Mich., claimed a share of the shipments from the Marquette range, this port and Marquette keeping company until 1879, when Escanaba took a liberal lead, chiefly by reason of the development of the Menominee range, commencing in 1877, and this lead has been continually maintained. In 1891, 3,058,590 long tons, or nearly one-half of the lake shipments, were sent from this port. Of this the Marquette range contributed 1,154,645 long tons, the Menominee range 1,480,248 tons, and the Gogebic range the balance, 423,697 long tons. Since 1865 there has been handled at the Escanaba docks a total of 29,963,257 tons.

The following will indicate how rapidly ore is handled by these docks: one steamer was loaded with 1,659 long tons of iron ore in forty-five minutes; others with 3,027 long tons in three hours, 3,132 long tons in four hours, 2,379 long tons in two hours, 1,927 long tons in two hours 2,502 long tons in two hours, 1,850 long tons in forty-five minutes. In this last case just one hour elapsed between the arrival of the boat at the dock and its departure. The record for the most rapid loading is that of 980 tons, which were run into a steamer in four and three-quarter minutes. The maximum quantity handled at the Escanaba docks into vessels in twenty-four hours was 42,320 long tons.

The nearly simultaneous development of the Gogebic iron range in Michigan and Wisconsin and the Vermillion iron range in Minnesota caused the erection of shipping docks, three for the former at Ashland, Wis., and two for the latter at Two Harbors, Minn., both ports making their first shipment in 1884. Ashland, however, soon outstripped its rival and in 1891 ranked second as a shipping port, with 1,261,658 long tons as its output. Since the docks were erected at Ashland in 1884, 7,760,025 tons of ore have been shipped.

In 1891, Two Harbors, Minn., ranked fourth, 890,299 long tons being shipped, and the total from 1884 to the close of 1891 was 4,030,899 long tons. Receiving docks are also projected at Duluth, Minn., to accommodate the anticipated increased shipments from the Mesabi Minnesota mines.

Gladstone, Mich., made its first shipment of ore in 1889, and serves as an additional and competing shipping point for the mines of the Menominee range. In 1891, 177,866 long tons were shipped.

The length of the seventeen ore-shipping docks, independent of approaches, varies from 400 feet to 1,800 feet. The aggregate of all being 19,342 feet, or (say) three and two-thirds miles. They contain 3,189 pockets, have a total capacity of 385,350 long tons, and cost, approximately, $4,500,000.

In connection with these docks the railroad companies own a total of 12,526 cars, built for use in transporting iron ore, with an aggregate capacity of 187,550 tons of iron ore, their total cost being estimated at $3,600,000.

Six mining companies on Lake Superior own a total of thirty-three vessels, mostly steamships, with an aggregate tonnage of 80,750, especially devoted to the transportation of iron ore, and maintained by the iron-ore producers.

Receiving Docks.—The bulk of the lake shipments of iron ore are taken to the lower lake ports—Cleveland, Fairport, Ashtabula, Toledo, Sandusky, Huron, Conneaut and Lorain, O.; Erie, Pa., and Buffalo, N.Y., for distribution to the various blast furnaces in Pennsylvania, Ohio, West Virginia, New York, etc. The remaining portion going direct to furnaces situated near to or on the Great Lakes, such as Milwaukee, Wis.; Chicago, Ill.; Detroit, Mich.; Tonawanda, N.Y., and to individual furnaces at various points in Michigan and Wisconsin. Most of the furnaces on the lakes or their estuaries have special appliances for handling iron ore, but it is at the first-mentioned ports on Lake Erie that the larger receiving docks are located, Cleveland having four, Buffalo three, Ashtabula and Fairport two each, and the remaining ports one each.

Two of the receiving docks at Cleveland are each half a mile in length and have a storage width of 350 feet; one at Fairport has a water front of one mile and a width for storage purposes of from 180 to 350 feet. As the ore is stored in piles from twenty-five to fifty feet in height, the capacity of each of these docks is from 1,000,000 to 1,500,000 long tons, and the average storage capacity of the receiving docks is 300 to 500 tons per foot of water front. During the shipping season, from May to October, the ore is brought to these ports, unloaded, a portion being handled directly to railroad cars and the balance stocked, being shipped to the blast furnaces during the winter months. The largest stock on hand at lake ports in the past nine years was on December 1, 1890, when 3,893,487 long tons were on the docks. The largest stock of ore at the opening of navigation was that on May 1, 1891, when the heavy stocks of the previous year had been reduced to 2,662,223 tons.

Mr. George H. Ely, in a paper, entitled "The Great Lakes of North America,"* gives some interesting figures in regard to the capital invested in iron ore mining and transportation in the Lake Superior region. The amount of capital invested in the iron ore lands, shipping and receiving docks and their equipment, in railroad cars, vessels, etc., was over $175,000,000.

Concentration of Iron Ores.—Considerable interest has for several years been exhibited in the concentration of magnetic iron ores by means of magnetic separators. This is not a novelty, as the United States Patent Office has issued nearly 150 patents (some of them half a century old) for various forms of magnetic separators. The revival of interest in the concentration of lean magnetic iron ores is fortunately at a time when improvements in machinery for reducing in size and handling large quantities of material are supplemented by advanced knowledge of electro-magnetic appliances. The extent to which the process can be applied commercially to many ores, can be decided only after a thorough investigation, embracing the chemical and physical characteristics of the ore, the quantity accessible, the facilities for obtaining it, and the available market for concentrated ore.

This method of beneficiating iron ores is confined to magnetite, or possibly to some ores which can by roasting or other process be made sufficiently magnetic to permit of their concentration by the appliances mentioned. Most of the work done has been in enriching lean magnetite, although some ores carrying high percentages of iron have been fed to magnetic separators for the purpose of reducing the amount of phosphorus and sulphur. The predominance of magnetic iron ore in New York and New Jersey, and the existence of large deposits of this class of ore in Pennsylvania and North Carolina, have naturally attracted to these States most of the development in concentrating plants.

There is no question but what the amounts of sulphur, phosphorus, silica, and in some cases titanium, existing in magnetites can generally be considerably reduced if the material is sized and passed through magnetic separators; the degree of perfection reached being influenced by such reduction in size as will actually permit the mechanical separation of the pure magnetite from the other ingredients. In some of the titaniferous iron ores, this element is so combined as to be magnetic, and similarly the sulphur in other ores is in such combination as to make it partially magnetic. It may be possible with improved machinery and greater knowledge to separate various materials from each other, which differ but slightly in magnetism, but present practice is confined to separating magnetic from non-magnetic material, and the results achieved depend largely upon the comminution of the material, the rapidity with which it is fed on the separator and the perfection of the machine.

We may consider the term "concentrates" as applied only to ore which has been comminuted by means of crushing machinery and then passed through water-jigs or magnetic separators to remove materials which lower the grade of the ore.

In jigging, the crushed ore is agitated, water being

* The lecture was illustrated by numerous lantern slides.

* International Congress on Inland Navigation. Paris, 1892.

introduced, which removes the lighter material, while the heavier iron ore sinks and is conveyed from the jig as it is separated. It is in this way that at Lyon Mountain, N.Y., the Chateaugay Ore and Iron Company treats the lean magnetite taken from the mines, and a similar method is followed at Iron Mountain, Mo., for the separation of the leaner red hematites.

Magnetic separators have been in use for forty years, but it is only lately that this system has attracted much attention. Although the forms of magnetic separators vary, they may be classed under three general heads :

(1) Altering the trajectory of falling material by introducing the attraction of a magnet, to draw the magnetic portion away from the non-magnetic. Six of this class of machines are now used.

(2) Feeding the ore to a revolving drum or drums, in which is a magnet core, the shells of the drum being either of alternate magnetic and non-magnetic strips, or entirely of magnetic or non-magnetic material. In some of these drums the magnet core is wound so as to exert a constant polarity, in others a series of magnets in alternate polarity compose the core, and in some opposite drums are of opposite polarity. When two drums are used, they are placed so as to revolve toward each other, the ore passing between them, or they are arranged tandem, the drums revolving in the same direction, but sometimes at different speeds and with different degrees of magnetic force, so that the ore fed from one drum to the other receives successive treatment. Machines are also arranged with more than two drums. About thirty of this class are in use.

(3) Belt machines in which the ore is fed to a belt or series of belts passing under or over magnets or magnetic drums, the machines working sometimes in water and sometimes dry. In some of the machines the polarity is maintained continuously by means of pole pieces, in others the material is constantly submitted to magnets of alternate polarity, the belts being placed so as to run either vertically, horizontally, or on an incline, according as the conditions require. There are between twenty-five and thirty of this class now at work.

These separators are used either at the mines to enrich the ore, at steel works and rolling mills to remove the magnetic particles from slag and dirt, to separate iron ore from pottery clay or from emery—and in one instance iron ore occuring as a hematite with zinc ore is treated in a roasting furnace after being comminuted, and becoming magnetic, can be thus separated.

There is apparently a present field for magnetic separation in the States of New York, New Jersey, Pennsylvania, Virginia, North Carolina and Michigan, where there are large deposits of lean magnetic ores. The prejudice against the use of concentrated ore by some blast furnace managers has been largely overcome by practice, which has proven that properly concentrated ore contributes to the good working of the furnace, and in the future this class of ore may he used largely in place of some of the higher-priced ore brought to eastern blast furnaces. This class of ore has also been used in most of the direct processes, and any development of these will encourage a corresponding demand for concentrates.

During the year 1891 there were produced 16,802 long tons of hand-picked or cobbed ore, 98,546 long tons of magnetically separated ore, and 110,777 long tons of jigged ore.

Conclusion.—In presenting for your consideration the subject of this evening I have relied mainly upon the eye believing that in this way it would be possible to convey more information concerning typical features in an attractive manner than to weary you with theories and detailed statistics. Most of the time has been devoted to iron ore, because nearly all that we use or import is smelted to produce pig iron, and hut a portion of the coal mined or limestone quarried enters into the production of iron. But the small attention given the fuel and flux must not be considered as a gauge of their importance. The mining and quarrying, the preparation, the handling of the raw materials entering into the manufacture of pig iron supplies work for an army of laborers, miners, mechanics, railroad men, sailors, clerks, engineers, superintendents and managers, and demands the investment of many millions of capital.

The Luhrig Process of Washing and Treating Coal.

By Mr. James I. Anson, Darlington, (Read Before the Cleveland Institution of Engineers.

In this paper it was pointed out how the coal owners of Saxony had been driven by the development of their trade, thei ncreasing demands of which the better seams soon became inadequate to supply, to seek for a method of treatment which would enable them to put the produce of their inferior seams upon the market in such a state as would satisfy the requirements of the iron manufacturer and other users of fuel, with whom coal of a considerable degree of purity became from year to year more and more of a desideratum. The earlier and rougher methods of coal-washing could only accomplish very imperfectly the purification of small coal for cokemaking. But Mr. Luhrig solved the problem with signal success so far as the elimination of mechanically separable dirt was concerned. Certain modifications and improvements have since been introduced, but every plant is specially designed to meet the requirements of the particular place, so that practically no two are precisely alike. When Mr. Rathbone wrote, he stated that the system was very generally adopted in Germany, and was fast making its way into France and Belgium, while it would not be long before it was largely adopted in England, but as regarded the last named such had not been the case. But the same causes which led the German coal owners to face the problem of the adequate cleaning of fuel—viz., the working out of the better seams, on the one hand, and the demand for a purer product, on the other, were now forcing the problem upon the attention of the English coal owners. Messrs. Merry and Cuninghame were the first to adopt the Luhrig process in Great Britain, and the success which had attended the working at the Motherwell and other collieries belonging the firm led to the formation of the Luhrig Coal and Ore Dressing Appliances Company, of which Mr. A. Cuninghame is managing director. On the Continent, about two hundred Luhrig plants were in successful operation, and a considerable number in Scotland and Yorkshire, while others were in course of construction. At Maryport the system had been successfully applied to coal for cokemaking. In Northumberland and Durham the system was, so far, unrepresented, but before long a complete plant for dealing with 1,000 tons a day will be in operation at the new Randolph pit of the North Bitchburn Coal Company. On the vital importance of a clean fuel in manufacturing operations, whether for direct metallurgical process or for the raising of steam, it was not necessary to dwell. Every blast furnace manager was fully alive to the necessity of using a coke as low as possible in ash and sulphur, and the frequent analysis to which coke was now usually subjected, both to ensure accuracy of results, and as a check upon the coke manufacturer, bore testimony to the fact that the question was most important. It was one thing, however, to stipulate for the supply of fuel containing a specified maximum of impurity, and another thing to get it with unquestioned regularity. Mr. Hawdon, in his presidential address to that institution in November, had remarked that as often as not 9 to 10 per cent. of ash was contained in the coke supplied nowadays as good blast furnace coke. The days were fast passing away of 5 per cent. ash in Durham coke. But if pure fuel was required in the blast furnace, it was equally important to have it in the puddling furnace, the heating furnace, and under the boilers. Yet, where did the iron and steel maker keep such careful watch upon the percentage of impurities in the coal supplied as the blast furnaceman kept upon his coke. The one was as important as the other. It had been estimated that the extra amount of coke containing 15 per cent of ash required, as compared with one containing only five per cent., amounted to about 17 per cent., to say nothing of the extra limestone needed in the blast furnace to flux the added 10 per cent. of ash. The comparative efficiency of coal containing 2 per cent. of ash as against one containing 14 per cent., was equivalent to a money value of 1s. 6d. per ton on the basis of a coal costing 7s. per ton. It might perhaps be said that the treatment of coal in such a way as to raise its purity to the desired point might be a costly process, and would so far increase the cost per ton that it might after all be better to use an inferior fuel at a lower price. By the adoption of a well considered scheme of handling, screening, washing, and loading coal as it came to bank, the whole of these operations could be achieved at an almost nominal cost per ton. At Motherwell, by the Luhrig process, the labor in handling, screening, handpicking, washing, and loading, did not exceed a half-penny per ton, whilst the saving in waste was an important factor. The Luhrig Company guaranteed under penalty that there should not be more than 2 per cent. of coal left in the final refuse, and it was found at Denaby Main that in daily practice this did not exceed one-half per cent. The author then considered the first principles on which the operation of every system of coal washing more or less depended, and showed that in order to effect a separation by washing, the bodies must be either of different specific gravities if of equal sizes, or of different sizes if of equal specific gravities. In the case of coal it was desired to separate the heavier dirt from the lighter coal. That could only be efficiently done when the mixed material was reduced to an approximately uniform size before washing, a principle which was rigorously carried out in the Luhrig system. This system of treating coal at the pit mouth was not one for washing only, but for the whole treatment of the coal, automatically and continuously, from the point at which it was delivered from the tubs to that at which it was delivered into trucks, storage hoppers, &c., including screening, hand picking of large coal, washing of nuts and small in as many sizes as might be reqnired, and automatic loading. In many cases only the washing plant with its attendant appliances was required. The plant in operation at Motherwell was a type of a complete arrangement for dealing with about 1,500 tons a day, including the whole of the processes involved in both dry and wet separation, automatic handling and loading. The plant treated the whole output of three pits, which was brought to one spot by endless rope haulage.

The tubs were run into tumblers, or kick-ups of an improved type, and the contents discharged over vibrating screens pierced with 2 in. round holes. All the coal above 2 in. passed from these screens on to long picking belts, formed of links in the usual way, but in place of plates to carry the coal there were steel bars with spaces between, so that any small coal due to breakage might fall through on to a table below the return belt. Cross shoes of angle iron, with a plate about 8 in. high, were attached to this belt at intervals, and as these were reversed and travelled backwards towards the screens they acted as scrapers, which collected the small coal which had fallen through and delivered it into the same hopper as received all the coal which passed through the screens. In cases where it was desired to pass unscreened coal over the picking belts, plates were used in place of the open bars. As it was carried along by the belt the large coal was picked by hand in the usual way, and at the end furthest from the screens the belt was carried round a movable arm which could be lowered into the trucks, into which the large coal was gradually and automatically delivered, the cross shoes preventing its slipping down with a run, and thus saving breakage. Any pieces of shale or dirt with inter-grown coal were thrown into shoots, which carried them to a stone breaker, from which they were delivered to the main hopper under the screens and underwent the same subsequent treatment as the rest of the coal, a large amount of coal being recovered in this way which ordinarily went to waste. With regard to the coal which had passed through the 2 in. screens, this fell into a large hopper beneath them, of about 100 tons capacity. Into this hopper had also been delivered the small coal due to breakage recovered from the picking belt and the mixed coal and dirt which had been passed through the stone breaker. The contents of this hopper were taken by an elevator to the top of the washery building and delivered down a shoot into a large sizing drum or revolving screen having concentric shells of different meshes. Here it was sorted into treble nuts 2 in. to 1¼ in., double nuts 1¼ in. to ⅞ in., single nut ⅞ to $\frac{5}{16}$ in. peas, and small $\frac{5}{16}$ in. and downwards. From the sizing drum each size of nuts was conveyed down a shoot into its own washer—a wooden box with a vertical partition extending for a portion of its depth, dividing it into two compartments which communicated with each other below. In the back compartment was a large wooden piston, actuated by an eccentric on a line of shafting which ran above the back of the washers, by which the necessary impulse was given to the water, the stroke of the piston being proportioned in each case to the size of coal to be washed. In the front compartment was a sieve on to which the coal was delivered from the sizing drum, an opening being provided in the front and near the top of the washer for the washed coal to flow out with the washing water, whilst near the bottom of the space above the sieve was another opening, adjustable by means of a sliding shutter, out of which the refuse passed. Any small dirt which passed through the sieve fell to the bottom of the washer, from which it was let out from time to time by a valve which passed it into the channel through which the rest of the refuse was conveyed to the refuse pit. The dirt or shale, together with such coal as might be adherent to or integrous with it, was carried by a spiral conveyor to an elevator, by which it was taken to a pair of crushing rollers, whence it descended again through a shoot to one of the washers, in which it was treated for the recovery of the intergrown coal. As the washed nuts left the front of the washers, they were delivered over perforated draining shoots, to which a shaking motion was given similar to that of a shaking screen, into loading hoppers. The small coal, $\frac{5}{16}$ in. and downwards, as it came from the sizing drum, met the overflow waters from the nut-washers and was carried into a grading box consisting of a wooden trough, under which was a series of inverted pyramids, in which the small coal was successively deposited in constantly decreasing sizes, the largest coal coming to rest first, the smallest at the further end of the series. From the bottoms of these compartments the coal passed to the small coal washers, which were like the nut washers, but in each had a layer of felspar crystals resting upon the sieve or grating through which the upward current of water was propelled by the pulsation of pistons of very short stroke. The layer of felspar slightly lifted and opened out at each pulsation of the water, closing again with the downward current. In that way the fine dust was allowed to settle down through the layer of feldspar. By that device, the use of a very fine mesh which would quickly clog was avoided. The washed fine coal flowed with the washing water down a channel to a revolving drum made of copper sheets pierced with holes $\frac{1}{64}$ in. in diameter, in which it was separated from the finest sludge, which was carried with the water in which it was suspended into the sludge recovery tank. The sludge recovery was a special feature of the Luhrig process, and it obviated the use of settling ponds, with the attendant cost of labor in clearing these. The water employed was used over and over again. The guarantees of the company at Motherwell, taking that as a sample, were :—(1) Plant to be capable of treating 1,500 tons of coal per day of ten hours on basis of coal containing 23 per cent. of ash ; (2) ash contained in washed coal $\frac{5}{16}$ in. to $\frac{1}{16}$ in. not to exceed 6 per cent., and for every 1 per cent. of ash left in the coal beyond that, the patentees to forfeit £100 ; (3) the rubbish or dirt washed out not to contain more than 2 per cent. of fine pure coal, and for every 1 per cent. above that, patentees forfeit £100 ; (4) cost of labor guaranteed not to exceed $\frac{8}{10}$d. per ton of coal handled, patentees to forfeit £150 for every 4-10ths exceeded, this to include labor in hand-picking, sorting, working and loading into trucks. However, the ash did not exceed 2½ per cent., the coal in the dirt 1 per cent., and the labor ½d. per ton. It had been proved practically that efficiency in results could be obtained at very small cost and with practically absolute regularity in working.

English mail to hand advises a better market for Canadian phosphate. Quotations for 80% having advanced to 10½d.

Messrs. Eugene Munsell & Co., of New York, report that the demand for Canadian amber mica for electrical purposes continues to steadily increase.

LEGAL.

A. A. Hayward and the Lake View Mining Co. vs. the West Waverley Gold Co., Ltd.

MOTION FOR AN INJUNCTION.

Before Mr. Justice Meagher in Chambers, on Tuesday, the 25th day of April, at Halifax, the plaintiff moved for an injunction to restrain defendant company from discharging the tailings from their stamp mill into Muddy Pond at Waverley.

It was claimed by plaintiff Hayward, one time manager of the Lake View Mining Co., that the tailings discharged into the pond backed up the water so that it flooded back into plaintiff company's mine. Defendant company produced affidavits showing that the level of the water had not been raised at all, and that the shafts of the plaintiff company were from eight to ten feet above the level of the pond.

The injunction was denied, Mr. Justice Meagher saying: "The motion for a restraining order is refused. The facts relied on by plaintiffs to show danger of their mine being flooded or affected by water being forced into it through the defendants operations, have been most completely met by the proof produced by defendants."

An order to serve notice in the matter of the injunction was obtained by plaintiff Hayward during the absence in the United States of the manager of the defendant company, and it was hoped to rush the matter through before he could return. This scheme failed.

An action for trespass and damages has been entered in the Supreme Court of Nova Scotia.

CANADIAN COMPANIES.

The Ophir Mining Co.—This company with headquarters at 418 Phœnix Building, Chicago, has been organized and is now actively operating the Ophir Gold mine near Bruce Station, Ontario. The property contains 154 acres and is situate, Lot 12, 3rd Concession of Galbraith, twelve miles north and and three miles east of Bruce Mines, district of Algoma. A force of 30 men are employed under direction of Supt. W. R. Wallace. An idea of the value of the ore may be gathered from the following returns of mill tests made by Prof. Fred. F. Sharples at the Michigan Mining School, Houghton, Mich.:—

First Sample. Total oz. Present.
Amnt. of ore, 1,525 lbs.....
Assaying silver, 2·3 oz. per ton.....Silver, 1·75 oz.
" Gold, 2·7 oz. per ton.....Gold, 2·6 oz
Concentrates, weight 140 lbs .....
Assaying silver 6·02 oz.....Silver, ·421 oz.
" Gold, 3·33 oz.....Gold, ·233 oz
Tailings, weight, 1,300 lbs..... ...
Assaying, silver 1·22 oz..... .....Silver, ·79 oz.
" Gold 1·57 oz.....Gold, 3·73 oz.
Gold and silver caught on copper plate (by difference).....Silver, ·54 oz., Gold, 2·00 oz.

"The amalgam was not removed from the copper plates at the end of this run, as we intended to continue on the following day, but an examination showed that there could not have been 2 oz. of gold upon them. This led us to think that the sampling of our ore had not been carefully attended to, so on the second run particular attention was paid to this, with the following results:—

Second Sample. Total oz. Present.
Weight of ore, 2520 lbs.....
Assaying silver, 2·05 oz. per ton.....Silver, 2·58 oz.
" gold, 3·5 oz. per ton.....Gold, 4·41 oz.
Concentrates, 2,371 lbs.....
Assaying, silver, 6·12 oz .....Silver, ·73 oz.
" gold, 2·68 oz.....Gold, ·318 oz.
Tailings, 2,200 lbs.....
Assaying silver, 1·21 oz.....Silver, 1·33 oz.
" gold, ·313 oz.....Gold, ·344 oz.
Gold and silver caught on copper plates (by difference)..... Silver, ·55 oz., Gold, 3·748 oz.

"According to our assays the amalgam from the copper plates should have yielded, when retorted, a button weighing 6·83 oz. The button we obtained weighed 5·33 oz. This button assayed 77·04 per cent. gold, consequently the amount of silver that we recovered upon the plates was very nearly what our assays of ore, concentrates and tailings led us to expect, while the gold found was about 1·5 oz. short of the amount that our assays called for. A small amount of this gold was left in the retort after distilling the mercury, probably a small amount remained sticking to the copper plates, and possibly a very small portion was not removed from the mortar. But the losses from these sources do not account for the loss of 1·5 oz. of gold. It is a well known fact that when free gold is present, in comparatively large pieces, it is impossible to get an average sample of the ore, and I believe this to be the trouble in our assays of the ore that we fed to the stamp. This idea is strengthened by the fact, that the silver assays and the amount recovered agree very closely, and further that the free gold does not occur in the ore in quite large pieces.

"During a close examination of some of the pieces of the ore, several small pieces were found carrying quite large pieces of the free metal, these I will forward to you with the button of metal. From these facts I should say, that the amount of metal recovered on the plate, together with the assays of the concentrates and tailings would be of greater value than the assay of ore alone. The runs that we made were upon five of the seven barrels that you sent. We wished to check our results with assays before working the remaining two. We used a 40 mesh sieve, and expected that we would find it necessary to use a coarser one in making another run, for we could see a quantity of galena and pyrites, particularly the former going into the tails.

"Our results show that it would not be advisable to use a coarser screen than this. It will be noted that our assays of the concentrates are rather low, and of the tailings rather high. Proper adjustment of the concentrator will overcome this to a great extent. I believe it is almost impossible to get any concentrator adjusted until several tons have been run through.

When crushing to 40 mesh, it will be noticed that a large amount of galena passes into the tails. To ascertain what loss this occasioned, I assayed some of the galena (as nearly pure as I could get it) and found it to contain 23·5 oz. of silver per ton, with only a trace of gold, and as the amount of galena is comparatively small, the loss from this source is not great. To ascertain the nature of the pyrites, I assayed samples and found them to contain 14 ozs. of gold per ton, with no silver. This shows that every means should be taken to prevent the loss of pyrite."

The mill now being built by the Doty Engine Co. of Toronto, will contain 30 stamps of 850 lbs., and, operated by 100 h.p. boiler and Corliss engine, will have a capacity of 50 tons per 24 hours. Ten frue vanners are in place. The mine itself will be equipped with two 50 h.p. boilers, Ingersoll compressor and drills, Blake rock breaker, etc. No hoisting engines will be used, the ore being handled by tram cable. Superintendent Wallace describes the workings to date as follows: The vein has a dip of about 40° south to a depth of 100 feet from the lower outcrop, here it comes in contact with a fissure in the syenite which takes it up and this fissure has a trend of 15° N. of W. and outcrops at intervals for a distance of 1,200 ft. from the present workings. East of this for 450 ft. the surface rises abruptly and along a cliff until the summit is reached (about 300 ft. elevation), an immense chimney of ore is exposed, with three distinct folds, the average width of which is 35 feet, through which I have made three cross-cuts and along which I am now drifting. At the lower part of where this chimney outcrops I have sunk on the vein 86 feet following the dip as above stated, about 40° south of this 170 feet and on the fissure I have sunk a shaft vertical and with the fissure, here at a depth of 90 feet I have reached a large body of high grade ore and have the drift within about 30 feet of this point, (the foot of the shaft), making the following estimate of ore, *i.e.* 200 feet in depth (which gives a margin of 50 feet), 30 feet in width, and 450 feet in length by actual measurements, all in sight we have allowing two ton to the yard which allows another third margin, and at half the value reported by Prof. Sharpless, we have such a value as would seem fabulous. And yet I do not believe half of the magnitude of this ore body has been estimated, nor can it be at present understood, but all the figures given can be verified anytime."

The Tulameen Improvement and Hydraulic Co. Ltd.—This company has been registered (in 1891) under the laws of British Columbia, with a capital of $60,000, for the purpose of acquiring and consolidating certain leases known as the "Tulameen" the "Hines Creek" and the "Eagle Creek," claims situated on the Tulameen River, in the Yale division of British Columbia. The workings are distant from Kamloops station on the line of the C.P.R., about 125 miles by wagon road and trail. The claims owned by the company extend from Eagle Creek a distance of two and a half miles down the Tulameen River, and contain large benches or alluvial deposits of platinum and gold bearing gravel.

Platinum was first discovered in the gold placers of this river and its tributaries in 1887. Up to that time it had been thrown away as "white iron" by the few whites and Chinamen mining in the vicinity. Since 1887, about 1500 to 2000 ozs. per annum have been mined and sold from the shallow diggings worked by hand. This can be verified by the official Mining Report of British Columbia for 1891. The platinum was sold to Baker Bros., of Newark, New Jersey, and Johnston Matthey, of London. In the shallow places referred to as worked by hand, the daily amount of gravel worked averaged from 3 to 4 yards per man, and the object of the present company in obtaining leases of the larger bench deposits, is to carry the water from Eagle Creek on to the ground and work from 3,000 to 5,000 yards per diem.

The following excerpts from the report of Mr. George Attwood, M.E.,, F.G.S., will be of interest:—

"From all data obtained, gold was first discovered and washed in and about the bed of the Tulameen river in the year 1886, and large quantities of platinum were then found and often thrown away as it was frequently unsaleable. A large amount was sold for 50 cents an ounce; but later the agents of American firms bought the platinum up from 50 cents an ounce to seven or eight dollars an ounce. Mr. Thompson, who has a store at Granite Creek within 15 miles of the mines and who trades in gold dust, etc., estimates that from 14,000 to 20,000 ounces of platinum have been produced in the district and that it has nearly all come from the neighborhood of the T. I. & H. Co.'s claims as the platinum bearing ground appears to be limited to that portion of the Tulameen river. Eagle Creek supplies the water for the mining work and the supply at the time of inspection was fully three times in excess of what was being used. The T. I. & H. Co., own the exclusive water rights. In Eagle Creek owing to its height above the Tulameen river and its gravel benches it is of great value as it provides the necessary power for hydraulic piping.

For cutting timber and making boards, &c., a saw-mill has been erected near the junction of the Tulameen river with Eagle Creek. The power employed consists of an overshot wheel 20 feet in diameter with a four foot breast which drives a 40 inch (in diameter) circular saw having a capacity of making from 1,000 to 4,000 feet of boards a day. Across the Eagle Creek, a dam has been constructed of heavy stones and logs in a deep gorge which forms almost a natural dam, is about 25 to 30 feet across and is about ten feet deep in the centre. A water flume about one mile in length carries the water from the dam to the present point of hydraulic working. The flume is made of one and one-half inch plank and is five feet wide in the clear, and twenty inches high except a short distance at the lower end where it is about eleven inches high. The general grade of the flume is one-half an inch in twelve feet, although it is not quite as steep in some places. The foundation of the flume had to be made for some distance, by blasting a bed out of the solid rock around the mountain side and the work has been well done. For saving platinum and gold a bed rock flume has been constructed 160 feet long, about 43 inches wide at the bottom and 27 inches high with 8 inches fall in twelve feet. The flume is provided with wood block riffles 5 inches high and three abreast, and with two under currents near end for saving the finer species of metal. At the end of the flume a penstock is in place and to which is attached about 300 feet of steel pipe in 10 in. in diameter No. 14 sheet, and having a monitor and justable nozzle which can be moved by hand and by which the stream of water can be directed on the gravel bench at any angle with a nozzle 4 in. in diameter. The pressure of water now being used is about 110 feet vertical and the quantity about 350 to 400 miner's inches. The Tulameen river has from all appearances, gradually cut its way through the country rock until its present level is far below what it was in ancient times, and in doing so it has left banks sometimes on one side and sometimes on the other of large benches of gold and platinum bharing gravel. The benches vary in length and width according to location, and out of the four miles on the run of the river, fully one-half (say two miles) is covered with the gravel.

The cost of removing one cubic yard of gravel by the use of free water which the T. I. & H. Co., Ltd., enjoy should never exceed ten cents per cubic yard, and with proper management 6 cents a yard should cover all the working expenses. To estimate the quantity of platinum and gold bearing gravel on the benches belonging to the T. I. & H. Co., Ltd., is a very difficult matter, but a walk on the ground will soon convince any one that the supply is enormous and that it will take a number of years to exhaust the same. The sum of $12,000 will place the property in a strong position and enable a good profit to be made. My opinion is a favorable one and I consider the property to be one of great value.

There are some gravel benches between the Bear Creek bench and the Otter Flat on the Tulameen river which are likely to contain platinum and gold. I have suggested that leases should be obtained for the same so as in order to control the platinum belt.

ANALYSIS.—No. 1—"Home Rule bench," one-fourth cubic yard; 15·50 grains of platinum and fine gold. No. 2 "JerryO'Donnell bench," one-half cubic yard; 11·70 grains (7·80 gold and 3.90 platinum). *Upper Bench*—3 cubic yards; 17.70 grains of platinum and gold; about 40 per cent. platinum some mercury on gold from pan.

The directors of the company are Capt. R. G. Tatlow, Vancouver; Joseph Armstrong, New Westminster; Dr. McInnes, Victoria; head office; J. Walker, secretary, New Westminster, B.C.

New Brunswick Brown Stone Co.—Is applying for charter of incorporation with the object of carrying on a general business for quarrying, manufacturing and purchase and sale of building and other stone. Directors: Stephen Clarke, Sackville, N.B.; Wm. Clarke, Sackville; Josiah Wood, Sackville; Wm. Milner, Sackville, and Henry A. Powell, Sackville. Capital, $10,000. Head office: Sackville, N.B.

The Cown Oil Co.—Is applying for charter of incorporation under New Brunswick Statutes. Capital, $50,000 in shares of $100. Directors: Geo. R. Sangster, Moncton; John W. Lowe, Stonehaven, and W. P. Whitehead, Fredericton, N.B. The objects of the company are to acquire lands producing or bearing oil, the sinking of oil wells and the working of such oil, the selling and dealing in oil, the erection of works and buildings, etc.

General Mining Association Ltd.—Subjoined is an excerpt of the annual report of the General Mining Association Limited, presented to the shareholders on the 21st April:—

The directors present to the proprietors their annual report, together with the accounts of the year ending 31st December, 1892.

The sales of coal were as follows:—Sydney mines, 170,080 tons in 1892; 151,584 tons in 1891—increase, 18,496 tons. From the colliery worked by the Low Point, Barrasois and Lingan Mining Company:—Victoria mines, 108,660 tons in 1892: 96,990 tons in 1891—increase, 11,670 tons.

The profit on the year's trading, as set forth in the accounts, amounts to £13,284 18s. 2d.; brought forward from 1891, £1,060 9s. 2d., making £14,345 7s. 4d., out of which the directors propose a dividend of 10s. per share, £13,734 10s., leaving balance to carry forward, £610, 17s. 4d.

There was a brisk demand for coal at the opening of the season, and large shipments were made during the first two months after navigation opened. Enquiry fell off somewhat in the summer, but autumn brought an average demand, which increased towards the close of the year, and, as the harbour remained free from ice, considerable shipments were made at both collieries in December, towards the close of which month, however, an unfortunate accident to the boilers at Victoria brought operations at that colliery to close.

Though prices generally were hardly so good as in the previous year, and increased royalty was levied on much of the coal sold, still the results have, as a whole, been satisfactory, admitting of a dividend of 10s. per share.

At Victoria mines the year's resul has again, unfortunately, not come up to expectation. The Board have have made now, however, a change in the management, which they hope may lead to better results this year.

The sale of the Bridgeport property was, as the shareholders are aware, carried through during 1892, but as the purchase money has not yet been fully paid, the Board do not recommend dealing with it until later.

There is as yet nothing further to report as to the proposed sale of the properties of the association."

New Hot-Blast Stoves.—Messrs. McClure & Amsler of Pittsburgh, have designed a hot-blast furnace which is a modification of the Massicks and Crooke's stove, and a number of this modified form of stove have been erected in the United States. The main object aimed at is to effect at the top of the stove a connection between the vertical flues and the stack flue, so constructed as to obviate the liability to fracture of the walls by expansion and contraction. This is effected by making the connecting passage in the form of an arch made separate from the crown of the stove, so that there is an intervening space instead of flues in the crown itself. In this pipe stove there is no combustion chamber beneath, but there is a small one at the end where the gas enters, is ignited, and passes into the oven through slots in the partition wall. There are thirty pipes in each section of the ovens as erected at the Grand river blast furnaces, Kentucky, each pipe having 65 square feet of heating surface. At Durham where these pipe stoves have been in use since 1876, it has been found that 100 pipes, or 6,500 feet of heating surface, will heat 16,000 cubic feet of air per minute, and that with regular running a temperature of 1000° F. can be maintained. At the Grand river, the double stoves, each with 3,900 square feet of heating surface, maintained the above mentioned temperature without difficulty during a run of ninety days, 8,300 cubic feet of air being blown per minute.

Keeping Open Haulage Roads.—Mr. W. H. Chambers* describes the methods adopted for removing the posts of coal along the main haulage roads at the Tankersley collieries. The coal is here worked on a modified long-wall system, leaving posts from 20 to 40 yards thick on each side of the main road. The shaft is 100 yards deep, and from it there is an incline about 1,000 yards long, with a travelling road parallel to it, and 10 to 12 yards of post between them. On either side of these roads posts 25 to 30 yards had been left. From the bottom of this incline levels have been driven some 800 yards or more, with posts in the main part of their lengths. There is also a second incline. In the main incline and levels there is a double line of rails with endless over-rope haulage. As the weight was coming on, owing to workings in another seam, and as the coal in this seam was becoming worked out, it was necessary to take some steps to keep these roads in good condition. Three methods were adopted. In the first of these, the low side posts were taken out from the far end, keeping the packing well up to the coal. A ripping of three feet supplied packing material. After about six months the top side was taken out in 40 yard pieces, and another ripping of 3 feet made to supply packing. Steel bars were set where the roof required it and the work was done without stopping the haulage. In another level the top side was taken out first. In the main incline, 6 or 8 yards of coal on each side was first taken out, 3 feet of the roof ripped down, and a pack 4 yards wide put in. Then the other portion of the coal was worked out 25 yards behind in bank form. In the second incline, the whole of the coal was taken out at once in several places.

*Paper read before the National Association of Colliery Managers, Leeds, April 30, 1892; The Colliery Manager, vol. viii, pp. 86-87.

The Microscopic Examination of Coal.—J Wiesner* states that the chief constituent of lignite is a substance which is brown, transparent, and is decolorised by chromic acid, leaving a residue which shows the reactions of cellulose. As, however, this does not withstand the action of chromic acid, it follows that lignite is completely decomposed by chromic acid, or rather by the mixture of potassium bichromate and sulphuric acid, which the anthor employed. The other kinds of fuel which were examined ranged from anthracite through coking coal to charcoal, lamp black and graphite. These all contained some of this substance, destructable in chromic acid, which was observed in lignite, though usually in very small quantities. Examined under the microscope in the form of a fine powder, the chromic acid solution in contact with the fuel becomes in the first place brown and finally green. The residue, even after having been treated for some weeks with fresh solution, shows no sign of any change. It behaves like amorphous carbon, and at the ordinary temperature is only attacked by chromic acid with extreme slowness. Anthracite consists in the main of the black material scarcely at all affected by a chromic acid solution. It also contains a transparent, deep-brown colored substance, which is slowly oxidised by chromic acid, but leaves no cellulose residue. Bituminous coal appears to be a mixture of lignite and anthracite leaving a small quantity of cellulose after the chromic acid treatment. Brown charcoal is completely decomposed by chromic acid, cellulose being readily observable. Black charcoal, on the other hand, is scarcely attacked.

Devices for Preventing Over-winding.—A. Kast† observes that of the hundred and one cases in which the winding-rope or chain broke in the kingdom of Saxony between the years 1884-1891, it was proved that no less than twenty were due to over-winding. In consequence it was ordered in 1890 that at those Saxon mines where men are continually being hoisted or lowered in cages, some safety device should be introduced by which, in case of over-winding, the steam would be automatically shut off and the cage brought to a standstill. Automatic signals were also suggested, and the author describes two newly devised mechanical arrangements for throwing the engine out of gear in case of over-winding, steam being shut off and the break applied.

Canadian Oil Shipments.—We give in the following table the shipments of crude, refined and crude equivalent leaving Petrolea, Ont., for the first 4 months of 1893, compared with the shipments for the corresponding period of 1892 :—

	1892			1893		
	Crude.	Ref'd.	Crude. Equiv.	Crude.	Ref'd.	Crude. Equiv.
January	17,441	24,751	79,218	23,671	28,834	96,756
February	14,577	18,073	59,759	22,905	19,809	77,072
March	16,570	19,469	65,217	17,891	22,405	73,903
April	12,542	15,145	51,704	16,131	16,532	57,460

Monatshefte fur Chemie, vol. xiii, pp. 371-410.

† Oesterreichische Zeitschrift fur Berg und Huttenwesen, vol. xl., pp. 407-411, with illustrations.

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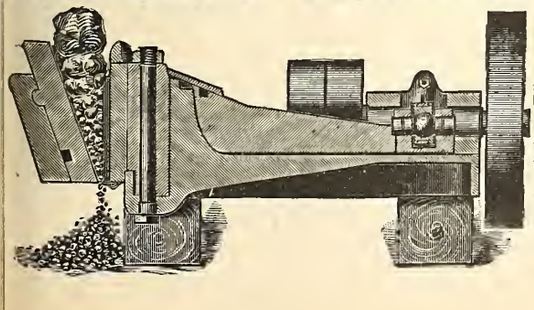

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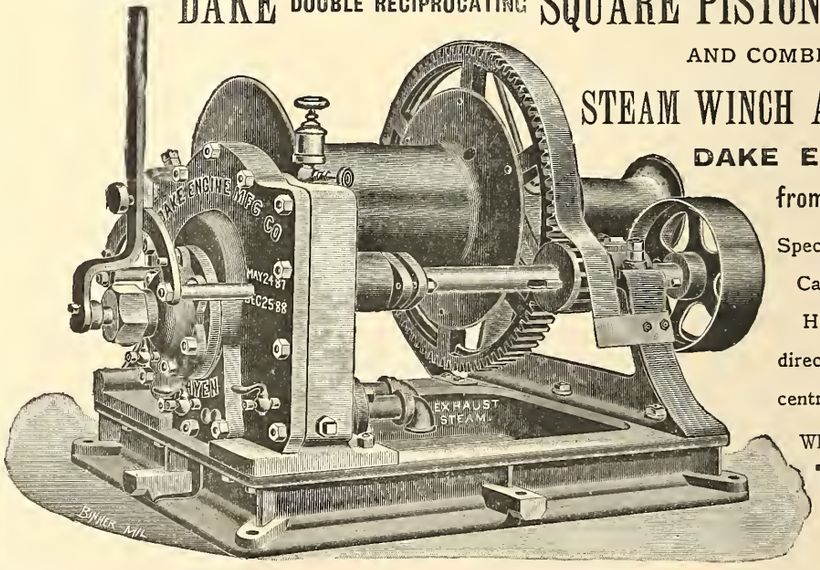

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Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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SOME REMARKABLE RESULTS IN GOLD EXTRACTING.

New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. &. Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

W. D. Sutherland, Secretary of the Salisbury Gold Mining Co., of Nova Scotia, after having over 4 tons of ore treated by the Crawford mill, says: "Sample of the tailings taken during the run showed by assay an equivalent to 0.033 oz. to the ton. This evidence of the capability of the Crawford mill to extract all but a trace of the gold which the ore may contain must be considered of importance by all who are interested in the question of improved methods of milling gold from the ore. The test alluded to was made under the supervision of our company through trustworthy agents."

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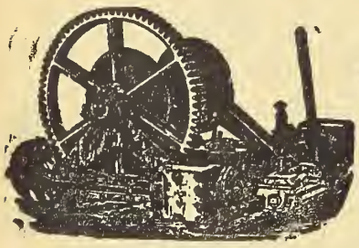

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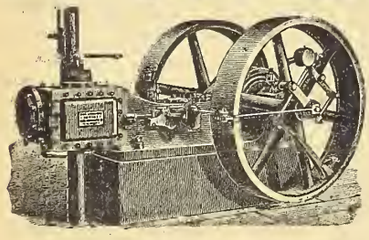

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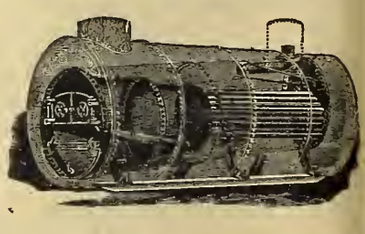

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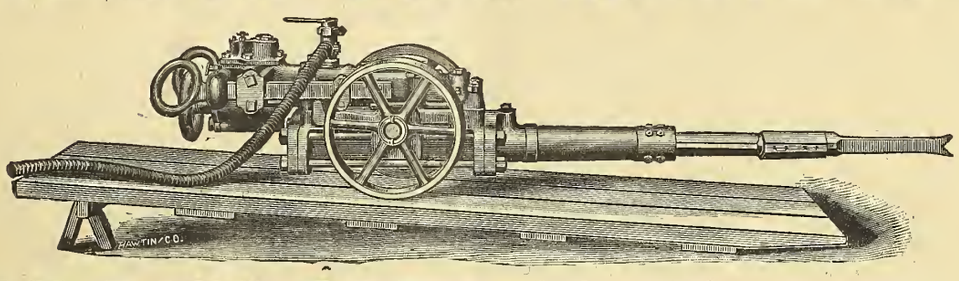

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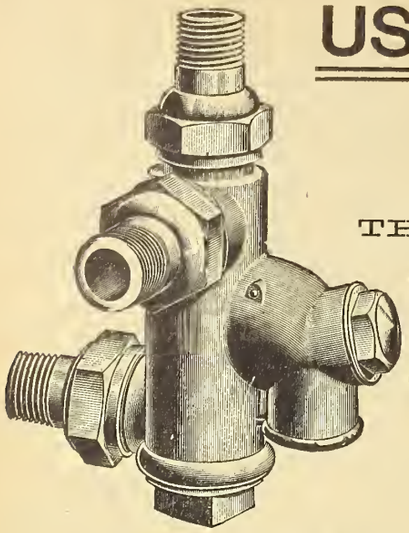

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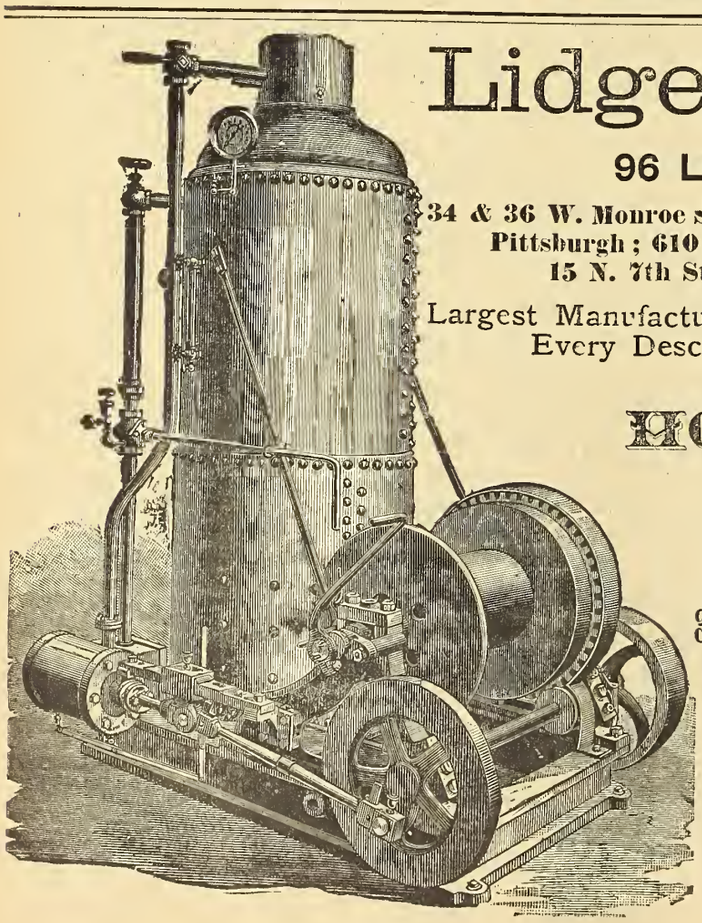

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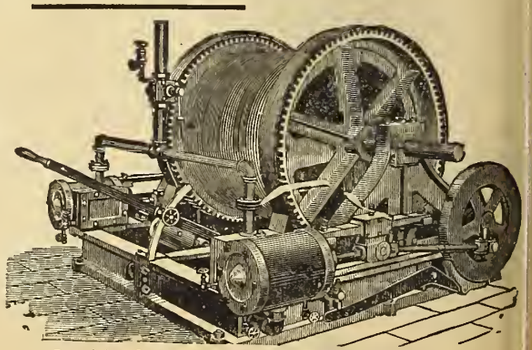

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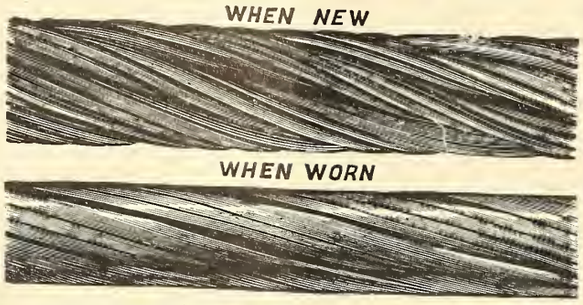

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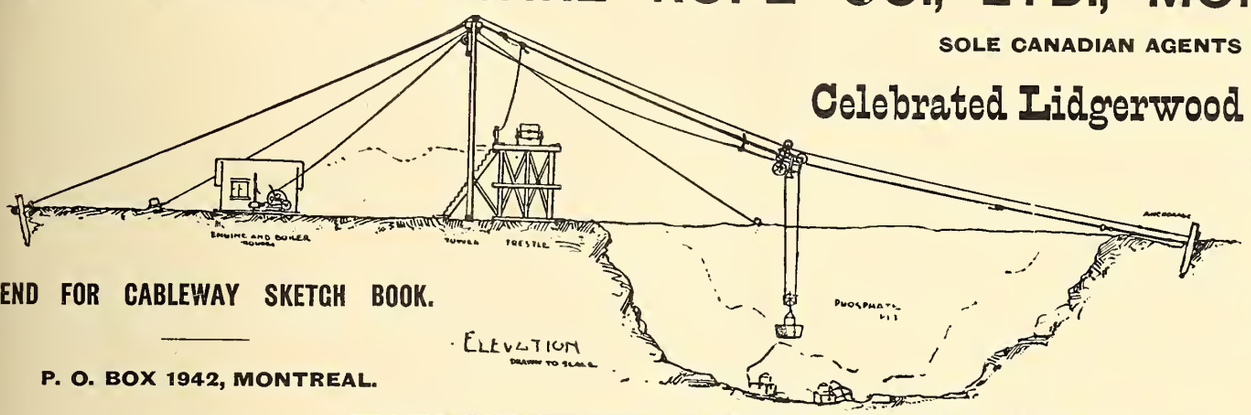

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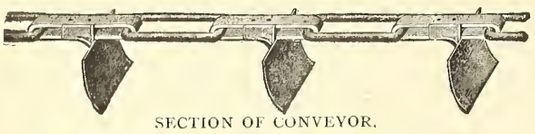

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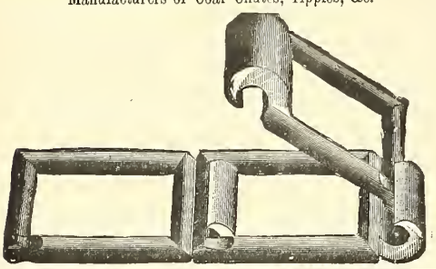

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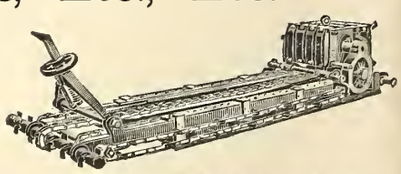

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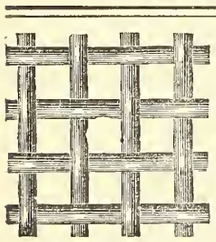

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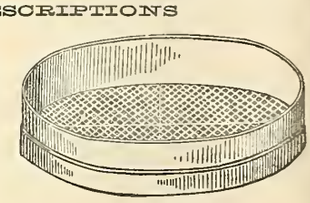

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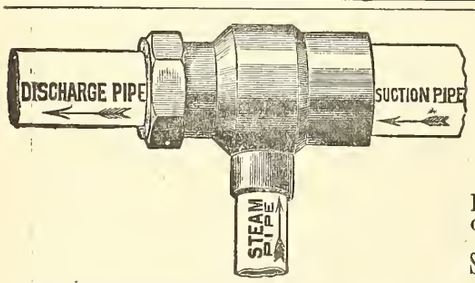

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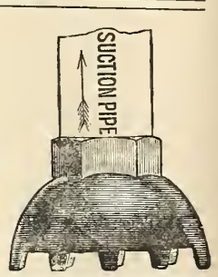

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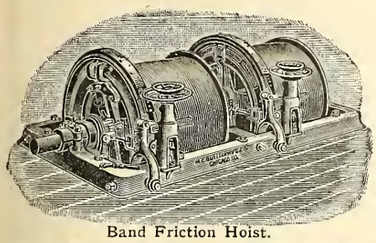

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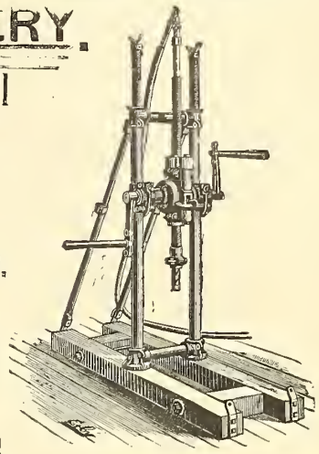

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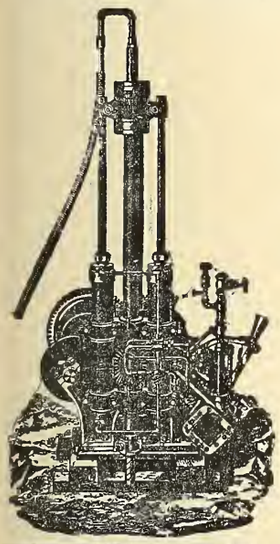

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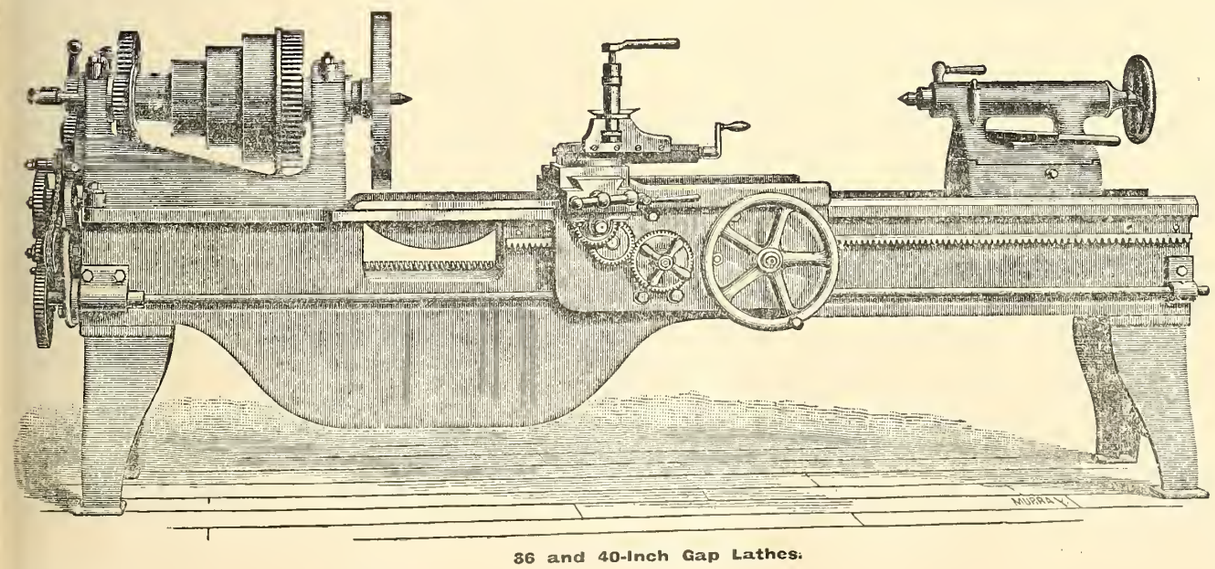

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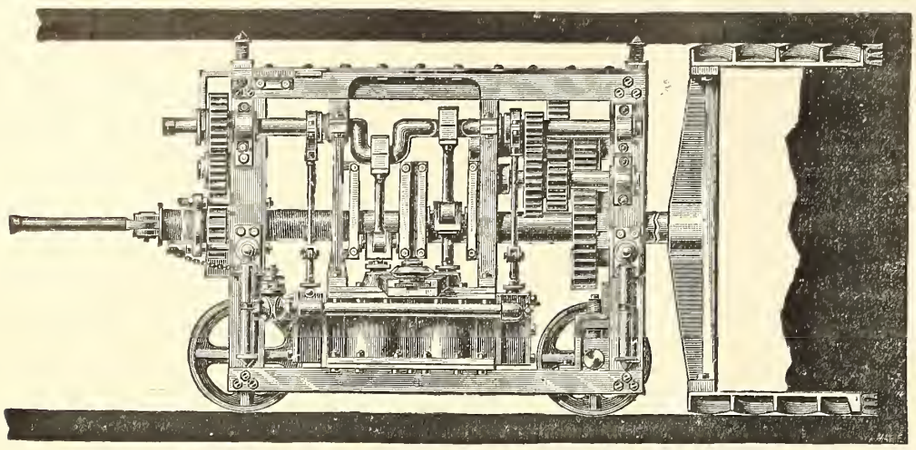

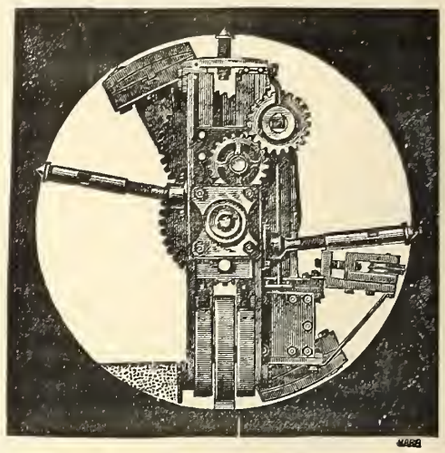

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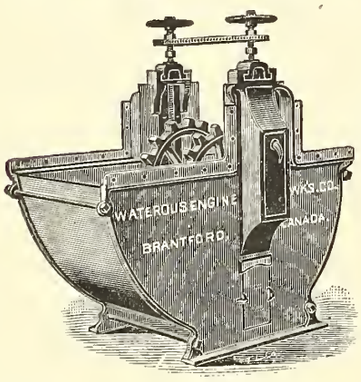

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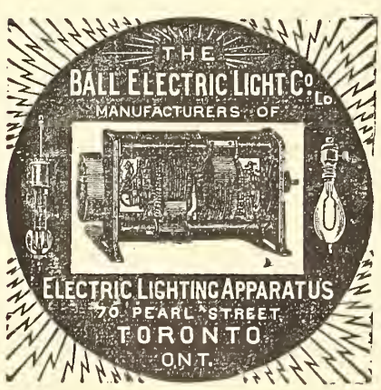

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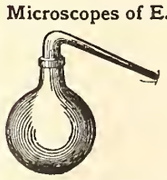

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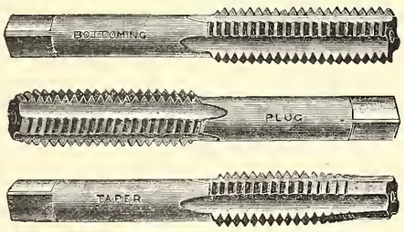

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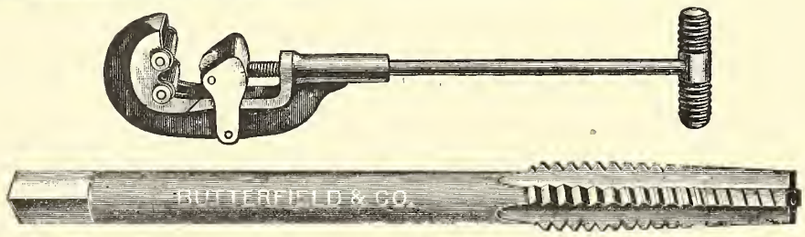

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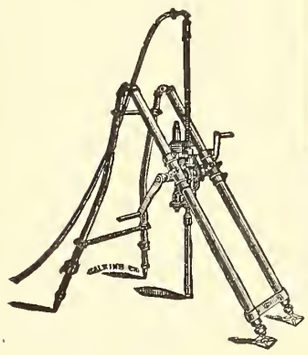

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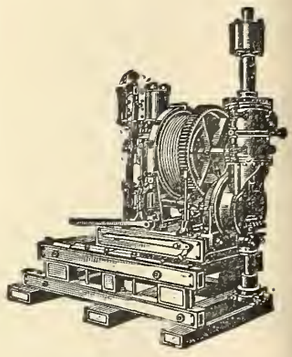

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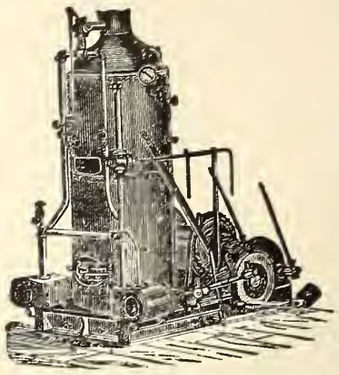

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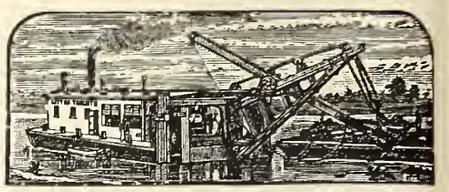

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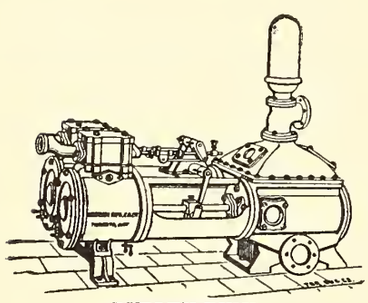

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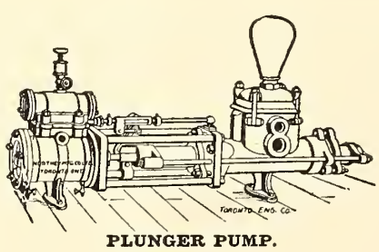

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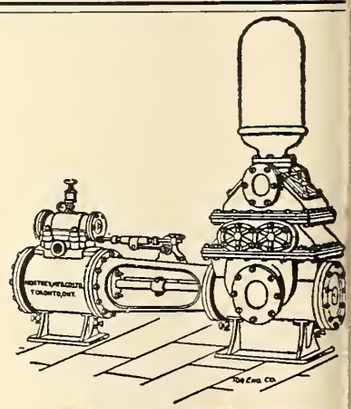

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Vol. XII. JUNE, 1893. No. 6.

THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QU EBEC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The Lake View Mining Syndicate Ltd.

Our article under the above heading in the May issue seems to have hit hard in an unexpected direction.

The purpose of that article, as clearly stated, was to call the attention of the directors of the Syndicate to some matters that we thought should be looked into before asking the public to subscribe.

It seems, however, from articles which have appeared in the Halifax *Chronicle*, *Herald* and *Critic* that a little clique of interested parties with headquarters in Halifax, have taken great offence thereat, and consider themselves personally attacked. The statements published all show such a similarity of thought and language as to warrant the belief that this clique is quite small, probably three or four in number.

We fancy we know the source of inspiration, and we know that the pecuniary interests and mining speculations of this clique are not likely to be benefited by having the REVIEW's search light turned upon any of their schemes, or on the methods they employ. The REVIEW has no fear of, and asks no favors from the promoters of any wild cat enterprise, and if the article referred to has made some such promoters uneasy, it is because they have knowledge that their methods cannot stand impartial scrutiny.

Any mining company or mine promoter that takes offence, and publishes angry paragraphs, full of vulgar adjectives, because we call attention to inconsistent and misleading statements, or make pertinent inquiries as to facts and methods, is accusing itself or himself of trying to foist upon the public that which will not bear investigation.

The REVIEW believes in honest and legitimate mining, in promoting the mining industries of the Dominion in all lawful ways, and one of those ways it conceives to be—fearless and impartial criticism, based on *facts*. In all that has been written on the REVIEW's article, we note nowhere any attempt to controvert its facts or to answer its questions.

The use of such words as "malicious," "unfair," "jealous," "rival," &c., *ad libitum* is easy, but it is neither refutation nor argument.

The public in Nova Scotia is so used to the vaporings of the *Critic* that anything emanating from that source calls for no reply. The *Herald* had the grace to publish a retraction in its very next issue, and to state that its article should have appeared as the contribution of an interested party; it also had the manliness to say that it knew nothing whatever of the merits or demerits of the case and that the article might be published in the best interests of Nova Scotia mining for aught it knew. But we are surprised that a reputable journal like the *Chronicle* should endorse a scheme of which it knew nothing except (like the *Herald*) what had been communicated to it by "an interested party."

We ask the *Chronicle* if it has carefully read the prospectus of this syndicate and compared it with the facts? and if so if it is prepared to approve the statements therein contained as true, fair, and in nowise misleading?

Will it endorse such a scheme as one likely to prove a benefit in any way to the shareholder, the mining industry or the fair name of Nova Scotia?

Does it endorse the past management of the Lake View Co. as successful? as efficient? as economical?

Will it kindly say how, when or where the REVIEW has in any way attacked the personal reputation of Mr. A. A. Hayward? and will it please say what there is in his record as a mine manager, or in the record of any mining property he has ever been connected with that any person could be jealous of?

In view of the fact that the REVIEW's article made no attack whatever upon Mr. Hayward's personal character the remarkable unanimity and promptness with which these newspapers, without replying to our interrogatories and without meeting or denying our statements, hastened to endorse his statements is, to say the least, significant.

From the general tenor of the *Chronicle's* article we infer that it considers Mr. Hayward responsible for the prospectus and its statements, we had supposed the directors and their mining experts were the responsible parties.

If the *Chronicle* is disposed to look into this matter it will find overwhelming proof of the justice of the REVIEW's article, and should it not be satisfied we shall be found very willing to give it additional and stronger evidence.

EN PASSANT.

To those of our readers conversant with the affairs of that colossal white elephant the General Phosphate Corporation Ltd., the announcement of the insolvency of Knud Sando, its promoter and late managing director, will not come as a surprise. It will be remembered that this Corporation was formed in London to acquire some 2,660 acres of undeveloped phosphate lands in the county of Ottawa, for £98,000 stg. The vendors received £20,000 stg. in cash, £17,500 by bills of exchange, and £57,500 on mortgages redeemable in five years. The nominal capital was £1,000,000, but £100,000 stg. was subsequently borrowed upon debentures secured by the properties and uncalled capital. After some two years of unsuccessful work operations were suspended, and the affairs of the concern are now being investigated by a committee of shareholders. As his share of the spoils, Sando actually received about £15,000 stg. promotion money, but he claims that out of that he paid £9,000 in respect of calls on his shares in the Corporation. He also collered some £11,000 stg. commission on the sale of the Stewart properties of the Corporation, and received a salary and expenses in managing its affairs. Not withstanding he ascribes his insolvency to the Corporation and to loss of business (whether as wool-broker, gold miner, or commission agent is not stated) owing to his absence in Canada.

Among Sandos's wild-cat schemes it is hardly necessary to remind our readers of his projected line of railway up the Lievres river, for which he obtained a charter from the Dominion Government. He also endeavored to secure a grant of lands in the North-West territory, for a colonization company, and gained some newspaper notoriety as the philanthropic promoter of a co operative scheme to benefit the Homestead strikers. Doubtless we will hear more of him and his little ways when the shareholders present the report of their investigations to the Corporation.

The Leeds Copper Company, which is the new name of the Excelsior Copper Company, (operating the old Harvey Hill mine at West Broughton, Que.) is already in difficulties, although the reconstruction only took place in January, 1891. The report tersely states that "the whole of the works have been shut down and beyond the wages of the caretaker no expense is being incurred." We should think even the cost of a caretaker might be dispensed with; for between January 16, 1891, and November 30, 1892, the company earned only £542 gross on a paid up capital of £284,405, and the expenses incurred in earning

this immense income were over £17,000. Under these circumstances, "it appears to your directors that the only course left open is to liquidate the company, with a view to reconstruction." That liquidation is necessary there is no doubt; but what object will be gained by a second reconstruction, beyond further loss to the shareholders and further fees to the directors, it is hard to see.

The slavering eulogies of the Halifax *Critic*, whose endorsement of the notorious Dobson and others of like ilk is well remembered must be very comforting to Mr. A. A. Hayward. He has our sympathy.

A contribution to the Halifax *Herald* thinks the REVIEW made an "onslaught on one of Waverley's gold mining industries" in its article on the Lake View Syndicate. We have made diligent inquiry and find this "industry" has been closed since April 1892. We were not (and are not) aware that locked buildings and absence of employees constituted an "industry." The same contributor imagines that the "criticism" is that of a "jealous rival." Did any one ever before hear of a rival to a moribund failure!

The Halifax *Chronicle* is quite right in saying that the functions of the REVIEW as an official organ of any Society cease with the publication of the official reports of that Society. No society, association, clique nor individual, excepting only the Editor, has any control *whatsoever* over the opinions or statements of this journal, which will continue in the future, as in the past, to be fearless in its exposure of what it believes to be wrong or detrimental to the mining interests of the country. No single article published in the REVIEW on a doubtful mining scheme has ever before in so short a time found so complete a justification of its warning as is evidenced by these acrimonious articles in the Halifax papers, which seek to make the matter one of personalities rather than one of *facts*.

With that characteristic caddishness and utter disregard of truth which has earned for it the contempt of the mining men of Nova Scotia, the Halifax *Critic* publishes a statement to the effect that a well known Nova Scotia mining man has a heavy financial interest interest in the REVIEW and that its editor must publish what this gentlemen sends to him. Now we need not tell our readers—for the personality of the REVIEW is thoroughly well known throughout Canada—that such a statement is a deliberate and malicious lie. Moreover the *Critic* knows it.

Dr. A. R. C. Selwyn, Director of the Canadian Geological Survey, again urges the opening of the museum to the public on Sundays. He says:—"There will doubtless be strong objections urged against such action, based chiefly, if not entirely on the very erroneous, but unfortunately very prevalent idea, that a muscum is a place of amusement, whereas it is essentially a place of instruction as is the church and Sunday school; and the principal difference between the two, concisely stated, is, that in the museum the *work*, and in the church and school the *word*, of the *Creator* is expounded. This admitted, there seems no obvious or intelligible reasons why the one establishment should be closed and the other opened on the Sabbath. Since the foregoing was written, I have sought opinions on this subject, and I have been much gratified to find such a large number of persons, including clergymen of various denominations, who regard the opening of the Museum on Sunday afternoons favorably, and think that to do so could not prove otherwise than advantageous to the community, and especially to that very large class of person whose daily occupations leave them no time in which they can avail themselves of the valuable information and instruction which the Museum is designed to afford."

All of which we heartily agree with. But in the meantime, if Dr. Selwyn is sincere in his desire to be a benefactor to the working classes, why not open the Museum on *public holidays*, and extend the hours of admission on week days so that the working men can study the work of the *Creator after four o'clock*. It seems to us much can be accomplished by the Doctor before he infringes on the day of rest.

The Hardy Patent Pick Company Limited, of Sheffield, are introducing a new patent disintegrator called the "Multiple," for producing fine and impalpable powders. This disintegrator reduces material by percussion, and is so constructed that the substances are subjected, as they progress through the machine, to the percussive action of several separate sets of beaters of increasing lengths and velocities, working in separate chambers. The whole circumference of each chamber is provided with serrated linings of excessively hard chilled iron, which are used as grinding surfaces, and this arrangement, it is claimed, gives about eight times the grinding surface of any other percussive disintegrator of equal size. The chambers increase in diameter as they approach the outlet, and the fan action of the large beaters in drawing the air from the chambers of the smaller ones, produces a through current of air from the inlet to the outlet. The material enters the smallest beating chamber, and from thence passes through the others, being subject to repeated percussive action, increasing in intensity in each successive chamber, and the current of air is continually carrying away the finished material. In the production of fine powders, this machine is not dependent upon grids or screens, as is the case with other percussive machines; but provision is made for a screen if it is deemed desirable to use one. This may be placed at the outlet, but it is not subjected to any beating action, and is only used when necessary to prevent any small pieces of unreduced material from escaping. The special features of this machine are its large grinding surface, its adaptability for fine grinding, producing a beautifully soft and even sample, and treating materials that cannot be dealt with in any other machine.

The total dividends paid by the Witwatersrand mining companies in 1892 amounted to £833,212, or about 16 per cent. of the gold output reported for the district; the greatest amount paid by any one company, £190,312 by the Robinson, being at the rate of 7 per cent. Other companies paying a less amount made a better return to their stockholders. Thus the Ferreira paid £56,250, or at the rate of 125 per cent.; the Crown Reef, £63,000, or at the rate of 55 per cent; the Jubilee, £17,502, or at the rate of 60 per cent. The Birthday Mining Company, in the Klein Letaba district, paid £22,150, or at the rate of 15 per cent. on its capital stock. The South African mines at present are making larger returns to English owners than these are receiving from their investments in any other country.

At the Rock Springs coal mine, Rock Springs, Wyoming, an electric locomotive has been introduced to haul a number of trucks a distance of 6000 feet. The current is supplied by a dynamo located a mile distant from the mouth of the mine, the generating pressure being 550 volts. The loss in transmission from the power house to the mine is about 10 per cent., so that the current received at the mine has an electromotive force of about 495 volts. The locomotive, which is of 60 horse power, is of 30 in. gauge, and it collects the current from an overhead wire, the rails forming the return. It hauls 30 trucks, which when filled weigh 40 tons.

How strangely one can sometime come across the ancient and the modern in machine-tools still working side by side in some of the engineering-shops! "The other day" says the *Iron monger*, "I went through an engineering-works in Lancashire, and saw the larger hammer, "Thor," put down by Nasmyth to forge guns, about forty years ago, and, although altered in the valve-motions, still running, and doing good work in forging cranks and shafts up to 10 tons weight. In the same works I observed several other of Nasmyth's tools, one a wheel-cutting machine made about forty years ago, and another the first slot-drill patented by Nasmyth forty-three years ago—both still doing excellent work, in company with similar tools made by the leading tool-makers of to-day—whilst in other portions of the work were some of Nasmyth's original patent shaping-machines, working alongside with others by Whitwork and Muir. Again, as illustrating how some so-called modern arrangements are very frequently anything but new, I noticed in one of the shops cast-iron coiled piping fixed around the columns for warming the place with steam, this principle of coiled piping, which has been applied as something new in recent years, having been fixed in these works for nearly half a century."

In the western parts of Mongolia, there are such rapid alterations of temperature that ordinary bricks, and even the usual building stones, disintegrate very rapidly. The inhabit-

ants of that country have a process for making extremely hard bricks, having the appearance of trachyte. In an article by M. E. Blanc, in *Dingler's Polytechnisches Journal*, the process is described, but the writer does not inform us as to the exact constitution of the clay. The brick kiln is in the shape of a vertical cylinder, surmounted by a dome. There is a rather large hole in the top of the dome, and during the first stage of the process the hole is left open. Three draught chimneys, built inside the furnace, open outwards at the height of the dome, and are kept closed with clay at the beginning of the operation. The kiln is heated for three days during the first part of the process, and then the hole at the centre of the dome is gradually reduced in size by means of blocks of moistened clay. The fire is allowed to die down, and the small hole remaining is covered with wet felt. The felt is covered with sand, which is continually kept moist. The three lateral chimneys are then opened, and the fire is lighted again. The draught is thus reversed, and the second stage of the process thus commenced lasts four days. During this time the water from the felt is heated and fills the kiln with an atmosphere of superheated steam. At the beginning of the second part of the process the bricks have a light red colour, but this changes to uniform dark gray. At the end of four days the bricks are finished.

There appears to be some development of the mica mining industry in Australia. The Australian *Mining Standard* in a recent issue has something to say editorially of a promising district, known as the McDonnell Ranges Mica field. Some idea of the difficulties under which the producers of mica labor in that country may be gathered from the fact that all packages have to be carried some 500 miles on camels to Oodnadatta station, the present terminal point of the great overland railway being constructed by the South Australia Government. Thence it is carried to Port Augusta and shipped to the most profitable markets. The *Standard* quotes values as follows:—Sheets of the size of 6 in. by 5 in. are worth about 5s. per lb., and their value increases with the size of the article, sheets 8 in. by 9 in. being valued at 10s. per lb., and those 12 in. by 12 in. being readily saleable at £1 per lb. The great want of the field is a man who is accustomed to practical working of such deposits.

Here's a pointer for some of our local Governments. The Australian Government has made a grant this year of $100,000 to aid parties in prospecting the resources of that county. Previously the vote was $200,000, (£40,000.) During the debate on this reduction one of the speakers proposed that the salaries paid members of parliament should be reduced and the amount saved added to the prospecting vote. Needless to say this excellent suggestion involved too severe a strain upon the patriotism of the members to permit any strong hope of its being carried.

The application of electricity for the purposes of power and lighting was, but a few years ago, looked upon as almost beyond the possibilities; but to-day there is scarcely a village that has not got its electric lighting plant, and the use of electric motors, for conveying power, where steam would be either impracticable or costly, is steadily increasing. The great advance in working metals with the aid of electricity began when it was shown that the process of welding could be gone through without subjecting the articles to the heart of the furnace, and now many operations are conducted with the electric current alone. One of the latest steps in connection with metal working by electricity is that of the Electrical Forge Company of Boston, U.S.A. They have brought out a machine for making round forgings by a rolling process, and the work accomplished by the apparatus is said to be simply marvellous. The machine can be worked at any speed, according to the class of work required, and it is readily adjusted in all its parts. It will successfully roll the highest grade of crucible steel or the open-hearth and Bessemer, as well as iron, copper, and brass, and it is claimed that all the work will be turned out solid. Among many other things of which the machine is capable of producing are steel handles of all sizes, and it is said that one hundred can be made in the same time that it takes to make one by the old lathe process. It turns out anti-friction steel balls from ⅛ in. to 2 in. diameter at a rapid rate, and the shape of each is perfect. They are cut from a steel bar which is inserted between the revolving dies, and each revolution of the machine forges a ball, the bar being kept heated by electricity. Hexagon bolts with head and thread are made in one operation, as are conical shells, shuttle tips, hinge tips, right and left hand threads, rolled steel cane, umbrella tips and bicycle spindles; in fact, any round-shaped article that will suit the size of the machine, of which ten sizes are made, ranging from 0 for the smallest work, to 10 for the largest forgings. Heretofore such work was done at considerable expense, as the finishing on the lathe required very careful manipulation, but with the new system it is claimed that the articles can be produced with a degree of accuracy as to size and shape that could not be obtained by hand labour. In general appearance the machine is simple and compact, and is geared up so as to obtain very great power.

The following method of determining lead in galena has been devised by Herr Rudolph Benedikt. The pulverised mineral is covered with water in a porcelain capsule, and then decomposed with a few cubic centimetres of commercial hydriodic acid of 1.7 specific gravity.

If the moistening with water is omitted there ensues a violent effervescence. The capsule is covered with a watch glass and heated on the water-bath, by which the lead sulphide is completely converted into lead iodide. When the change is complete, the whole is evaporated to dryness. The residue when cold is covered with dilute nitric acid, the capsule is covered and heated on the water-bath. The nitric acid decomposes the lead iodide, with liberation of iodine. As soon as the oxidation is at an end the capsule is uncovered, the contents evaporated to dryness, the residue is moistened with dilute nitric acid, filtered, and washed out, when the entire lead is in solution as lead nitrate, and may be determined with sulphuric acid in the usual manner. Lead sulphate can be converted into lead nitrate in a similar manner.

Messrs. Qualter, Hall & Co., Railway Foundry, Barnsley, England, have just completed for the Powell Duffryn Steam Coal Company a couple of screens with an endless travelling band of somewhat novel construction. The travelling belts, which work continuously, are 56 feet long and 5 feet 6 inches wide, made of steel plates carried on cast-iron standards, with angle iron slides and top and bottom rollers on each side of the band. The fixed screens consist of thirty-two bars each, 12 feet long, and 6 feet wide, and 3½ inches deep. The shaking screens are 6 feet long, and about the same width, and will distribute the coal on to the belts, from which the impurities will be removed by persons on each side of the former. The bands are made of steel plates 14 inches wide, and are all secured by three chains, with a link patented by the managers, and are geared down to 16·1, enabling them to travel at the rate of 40 feet per minute. The coal is taken from the screens from the ends of the belts by self-acting raising and lowering shoots on to the waggons placed at right angles to the belts. The belts, and, indeed, the whole of the appliances, are driven by a pair of cylinder engines which makes 100 revolutions per minute. The whole of the machinery is mounted on cast-iron columns and rolled iron girders. The quantity of coal which will pass over each screen and belt will be 600 tons each, or 1,200 tons in the course of a day of ten hours. The whole of the structure, including the bands, screen, &c., is about 100 feet long, and will weigh upwards of 100 tons.

Nickel steel for an experimental 8-inch breech loading rifle have arrived at the naval gun foundry Washington, and the manufacture of the gun will begin at once. Great interest will attend the construction and subsequent experiments with this gun. Nickel steel has never been used in the manufacture of guns, and it is thought that the non-corrodible quality of the alloy, coupled with other physical characteristics such as increased elasticity and extraordinary elongation, render it specially adapted for guns subjected to high pressures with nitro-powders. The forgings for this particular gun have 3.15 per cent. of nickel. The guns will be 304½ inches long and will weigh 31,300 pounds.

The minimum physical characteristics o the gun will be, for the tube, tensile strength, 85,000 pounds; elastic limit, 42,000 pounds; elongation, 20 per cent. For the jackets the same characteristics will be, tensile strength, 90,000 pounds; elastic limit, 45,000 pounds; enlgation

13 per cent. The gun will be of special design. It will be composed of only 3 parts—a tube, jacket and hoop—and will be assembled by means proposed by William Sellers, Philadelphia.

It is claimed for this class of guns that they can be dismounted after considerable service, the corroded or damaged tube readily removed and a new tube substituted, the old jacket and hoop being used on the new tube. Should the experiment be found a practical success, not only will the original cost of the gun be considerably reduced, but it will be possible after extensive use to make virtually a new gun by merely supplying another tube, the wear and tear on the jacket and hoop being of no particular account in firing. Mr. Sellers contends that the jacket and hoop can readily be removed by a process of artificial contraction and expansion, similar to that recently applied to the 13-inch gun.

A most interesting showing of the causes, the cost and the results of strikes in Great Britain is given in a report issued not long since by the Labor Correspondent to the Board of Trade. This report covers the year 1891, and starts out with the announcement that the strikes during this year were not so numerous as those of the year preceding. During 1891 there were 893 strikes, affecting so far as known 4507 establishments, and there were 13 lock-outs affecting 48 establishments. Disputes as to wages were the chief causes of strikes, 54.2 per cent of the total arising therefrom ; 30.23 per cent were due to demands for advance of wages. In the 3 previous years the proportion of strikes due to wages disputes was, in 1888, 62, and in 1889, 67 per cent on a rising market, the percentage of advance of wages strikes in 1890 was 42.4. The strikes against reduction of wages were 11.6, as against 8 per cent in 1890. In 1891 the strikers won 45 per cent of the wage strikes and 23.4 per cent were particularly successful. The number of persons engaged in the unsuccessful wages strikes was, however, much larger than in the case of the successful or partially successful strikes. One particularly interesting feature of the report is that referring to strikes against non-union workers. In 1891 there were 47 strikes of this kind in Great Britain, and 51 per cent were total failures. A general review of all the results shows that in 676 of the chief cases 266,885 work people were concerned. 369 out of 893 strikes were known to be successful, which is a proportion of 41.32 per cent, in which 68,247 persons were engaged. 181, or 20.27 per cent, with 98,117 persons affected, were but partially successful. 263, of 29.45 per cent, with 92,763 persons involved, were entirely unsuccessful.

As to the losses incurred by these strikes, the report presents an estimate, and states that a total of £1,500,000 in wages which might have been earned during the time taken up in these strikes. Reports from 237 firms state that the actual outlay caused by stopping and reopening their works amounted to £92,238. The trade unions spent £145,785 in sustaining 261 strikes. Statistics given by the trade unions apparently show that the strikes entered upon were not a total loss, for in 234 strikes of the year the weekly wages previous to these strikes were £89,667, and after the strikes they amounted to £94,325, an apparent gain in wages per week of £4,658. By following out the calculation and taking into account the loss of wages during the strikes it will be seen that a long period of advanced wages must follow before the workers can catch up with the cost of their strikes.

The report mentioned contains some additional statistics showing the trend of opinion among the employers and workmen of Great Britain as to the best means of avoiding strikes. In answer to a question of this character 222 employers made replies and 77 were in favor of arbitration boards specially appointed as occasion might demand. Out of 231 trade unions, 68 were in favor of the same mode of settlement, 21 employers and 19 trade unions were in favor of State boards of conciliation and arbitration. Conciliation, rather than arbitration was favored by 45 employers and 92 trade unions.

The gas trustees of Findlay, Ohio, after carefully going over the accounts for the fiscal year ending April 1, 1893, the receipts for March being now nearly all in, find that during the year the net profits of the gas office had been $56,500. This amount does not include the receipts from the factories for the gas consumed during the month of March, which will aggregate $5,500. This is not received until next month, so does not come in as receipts during the present fiscal year. If this were included, the total profits would be $62,000. During the past year the city has spent $20,000 on new pipe lines and mains which will not have to be laid next year, and this would indicate that the net profits of the plant next year will equal $82,000.

As a play upon mining terms and phrases, the the following contribution on the "wants of the miner," from a United States contemporary, is very good :—"He wants a 'false set' of teeth for the 'mouth of the tunnel,' 'stopping' for the old ones, and a girl of experience to paint and powder the 'face of the drift.' He wants a four-in-hand tie for the 'collar of the shaft,' and a boot for the 'foot of the incline.' He needs a jockey who can ride a 'porphyry horse,' and use the 'spur of the ledge' on a 'bucking donkey' (pump), and 'drive a crosscut.' He wants an 'expert' burglar to 'tap the ledge," a detective to 'follow the vein,' and a watchman to guard the 'silver plate." He wants a hat that will fit a 'head of water," and a man who can wear the 'cap of a tunnel-set.' He wants a solder who has been 'drilled' to handle a 'gun' and to 'shoot' and work a 'battery'; also a painter who can distinguish a 'color.' He wants a 'square set' of men to work for him, some feed for his 'giraff,' a bird for the 'cage,' a hunter to hunt a 'gopher,' and a 'grizzley' and a sprinter to 'run a drift' against time. He wants a tidy man who will put an 'apron' on and 'clean up' the mill, sweep up the 'dust' and 'wash dirt.' He also would like to have the Government furnish him with 'stamps' free of charge. He wants the 'roof of the drift' shingled with twenty-dollar pieces. And when he 'dies' he wants to go to the 'upper level' and play on a silver 'horn,' and have his 'slap-jacks' baked in a 'gold pan.'"

A most valuable addition to mining literature is the very comprehensive review of the mineral industry, its statistics, technology and trade in the United States and other countries, presented in a handsome volume of some 600 pp. by our esteemed contemporary the *Engineering and Mining Journal* of New York. This volume covers so wide a field that we can do no more at present than recommend it most heartily to every reader of the REVIEW who may desire a handy, serviceable, and reliable review of the minera industries of this continent. We bespeak a wide sale in Canada for this latest evidence of the snap and enterprise of our New York contemporary.

Mr. H. M. Wylde, secretary of the Mining Society, has issued his prospectus convening the June meeting of the Society, at Glasgow, on 29th and 30th insts. As intimated in a previous issue the proceedings promise to be of unusual interest. On arrival of the morning train (29th) from Halifax at Eureka Junction (Ferrona) members will be taken to the Iron Works, thence on to Bridgeville, where they will visit the mines of the New Glasgow Iron, Coal & Railway Co. who have undertaken to conduct the excursion, and to lunch the party. An opportunity will also be given to inspect the new works of the Pictou Charcoal Works, recently erected at this point. The first session will be held in the evening, in Bell's Hall, New Glasgow, commencing at seven o'clock. Among the papers announced are the following : "Prospecting and Mining Magnetic Iron Ores with the aid of Tiberg's Magnetic Inclination Scale," by E. Sjostedt, and a note on the "Occurrence of Manganese and Zinc Ores in Nova Scotia," from the pen of Dr. Gilpin, the Provincial Deputy Commissioner and Inspector of Mines. A Conversazione and Reception will be held in the same building at eight o'clock, when an address, on behalf of the local reception committee, will be made by the Hon. A. C. Bell ; to be followed by a short historical paper on "The Discovery of Coal and Iron Ore in Pictou County," from the Rev. Dr. Patterson (the historian of Pictou County). The proceedinge will be enlivened by music, and refreshments will be served. On the following day (the 30th) an opportunity will be given to participate in a visit to the steel works and collieries of this district, as well as a geological excursion to the Pass of McLellan's Brook. Needless to say that this attractive programme should conduce to make this the most successful outing yet held by the members of this energetic and enterprising

society. While the REVIEW unfortunately cannot be present on this occasion, its July issue, as usual, will contain a full report of the proceedings.

In these days of bank smashes and other unsettling events in the financial world, the feeling of distrust in monetary institutions which seems to be inherent among the more ignorant classes of the people is likely to gain strength and lead to a considerable increase in private hoards, The Boers are notorious for making their waggons their banks, and some curious questionings have been provoked in the United States by the discrepancy between the amount of gold known to have been produced and imported, and the amount officially returned as being in the country. According to the best available data, the authorities calculate that there should be fourteen hundred millions of dollars in gold in the country, but the returns only account for about half that amount, and the question is, where is the balance? It is thought that it is very largely to be accounted for by the hoarding-up tendencies of American farmers and others who either live at a distance too remote to enable them to avail of banks with advantage, or who have been unable to conquer their distrust of such institutions.

Further particulars of the new unfreezable explosive, 'Maximite,' are to hand. It appears that for four years the inventor, Mr Hudson Maxim, has been experimenting with smokeless rifle powders, making a specialty of nitro-compounds, and he has been successful in this direction. In the course of his experiments he found that the compound could be made so cheaply that it could compete with dynamite, and that he could, therefore, make with the guncotton a smokeless explosive for blasting. The material is now made by the Columbia Powder Manufacturing Company, of New York, and is said to cost no more for the same amount of work than dynamite. It is claimed that 10 ozs. of Maximite is equal in effect to 1 lb. of 40 per cent. dynamite. The products of combustion of Maximite are mainly carbonic acid gas and water. A specialty of this explosive is that it is unfreezable. It is also claimed that one cartridge cannot be exploded by the explosion of another standing beside, but not touching the first, that the material is difficult to set fire to, and that it cannot be exploded by striking with a hammer, whilst a temperature of about 400 degrees Fahr. is required to explode it by direct heat. It can be used for quarrying by packing the cartridge lightly so as to prevent the shattering effect required in mining and other ordinary blasting. The cartridges weigh about 14 oz., and are used in competition with the ordinary 1 lb. dynamite cartridges. It is claimed that Maximite is equal in power to pure nitro-gelatine, weight for weight. The comparative power of different explosives is as follows, the unit being black blasting powder: Black blasting powder, 1; dynamite, ordinary 40 per cent, 9; dynamite, No. 1, 75 per cent. nitro-glycerine, 13; guncotton, 14; nitro-glycerine, 16; blasting gelatine (nitro-glycerine), 17; Maximite, 17.

From the Broken Hill Mine (Australia) silver and lead of the value of over $40,000,000 have been taken within seven years; and it continues to yield about 220,000 ounces silver and between 600 and 800 tons lead per week.

In the report of the British Commission on Mining Royalties, not the least important portion is that which deals with what is called nationalization of minerals, which means that all minerals should be national property directly under the control and management of the state. This feeling found expression in the evidence of some of the representative miners, especially from Scotland, examined by the Commission. They advocated that the state should acquire the whole of them inerals of the country, whether worked at the present time or not, and should hold them for the benefit of the community. Several of the witnesses supported this opinion by the expression of a conviction that if the minerals were made national property, the well-being of the miners would be more carefully attended to than under present circumstances, while a portion of the proceeds might be applied to their benefit in the shape of provision for disabled miners and their families, and superannuation allowances. It was further urged that mines could be worked more economically than at present, which we fail to see; all past experience showing that private undertakings are far more economically managed than they could be by any department of Government.

A wide divergence of opinion, says the *Iron and Coal Trades Review*, showed itself amongst the witnesses on the question of the terms and conditions on which minerals should be acquired by the state. The most extreme view represented was that the state should take the minerals from their present owners without giving any compensatfon whatever. The reasons given for a proposition, which advocates wholesale legalized robbery, were that the minerals originally belonged to the Crown, and now belong "to the people as a whole." Private property in minerals was considered an injustice which ought to be remedied, while the benefit which private owners and their predecessors had already enjoyed at the expense of the public ought to be set against any claim which they might advance for compensation. Arguments such as these are hardly of a nature to commend themselves to a civilized community. It passes ordinary comprehension why minerals, which are acquired property, should not receive the same protection that other kinds of property enjoy. But the great majority of witnesses recognized the right of the present proprietors to compensation. To bring the scheme of the acquisition of the minerals by the state into full operation, however, it would probably be necessary for the state not only to own the minerals, but to work them. As this would raise another claim for compensation, that of the coal owners or lessees, whose capital has been invested in the enterprise of working and winning the minerals, something like £100,000,000 would have to be found to compensate them. What the sum would amount to to pay out the present royalty owners may be left to imagination; but it would be appalling. The suggestion of the nationalization of minerals was not approved of by a good number of the miners' representatives, while lessees, the persons most nearly interested next to the royalty owners, much preferred the present condition of the law of mineral property to remain as it is. Under these conditions, the commission was perfectly right in declining to discuss the subject further, leaving its solution, if it can be solved satisfactorily, to the time when the larger question of the nationalization of the land comes up. But that time is far distant as yet.

In the January number of the *North American Review*, the Hon. D. D. Field, a distinguished lawyer, has something to say of interest regarding the relations between employers and workmen. Speaking of the possible remedies for industrial strife, Mr. Field contends that compulsory arbitration is impossible because the state cannot fix the price of labor any more than that of corn or any other article. How then he asks "can the state as such aid in the reconciliation of capital and labor," and suggest that when capital applies for privileges the state may make the concession of them dependent upon an undertaking that labor shall also have a definite share in the accruing profits. As an illustration he gives the following example:—

"Let us imagine such an establishment as I suggest. Suppose a factory to be chartered, with a capital of 1,000,000 dols., divided into 200,000 shares of 5 dols. each, three-fifths of them to be payable in cash or property as at present, and two-fifths in prospective labour; the former to be invested in land, buildings, machinery, and whatever else may be necessary for such an undertaking, and the latter reserved for such workmen as may be taken into the concern; the skilled workmen to be allowed wages, say, for illustration, at the highest rates of the market, 4 dols. a day or more, and the unskilled 2 dols. a day, and each one to be registered for 400 shares. If the earnings were 6 per cent. on the capital, each skilled workman would be credited in twelve months—that is to say, for 300 days' work—with 1,200 dols. for wages and 120 dols. for profit. Deducting 500 dols. for his supplies, including food, clothing, and lodging, there would be left to his credit at the end of the year 820 dols., which would pay for 160 shares of the stock. He would then have had his living and become the owner of 164 shares of the company. In the next year he would acquire 164 additional shares, and in less than three years would have more than paid for all the 400. The rate of wages, the supplies furnished, the admission and dismissal of share workers, and the discipline of the establishment should be vested in all the shareholders, actual or expectant, while the financial department,

and the purchases and sales, should be in the hands of the cash or property shareholders. Capital and labour would thus be brought into closer communion, and made to lean on each other. To this end the requirement of a cash or property capital would be in part dispensed with, and instead of it an obligation to labour accepted. The share-workman must have the means of living while he is earning the price of his shares. He mus be enabled to live as cheaply as possible, by having his supplies furnished at the lowest price. He must have fair wages, and withal reasonable maintenance, and the prospect of bettering his condition by becoming a participant in the profits of the combined labour and capital. But all concerned should have the power of superintending the conduct of the workmen, choosing between applicants, and dismissing the idle or incompetent, recompensing them, of course, for what they have already earned and saved."

To such of our readers who may be interested in this subject, we commend a recent contribution by Mr. C. R. Iorns, to the Manchester Association of Engineers, in which much interesting data is given.

In the matter of the relative cost of fuel for glass factories between coal in a coal country and gas at 5 cents per thousand feet, Secretary A. L. Strasburger, of the Model Glass Company, at Findlay, O., states that his company was using 300,000 feet per day in its 14-pot factory, which made the fuel cost $15 per day. This was about 50 per cent. cheaper than oil, and about 10 per cent. cheaper thrn coal in the Ohio Valley. If they could secure a steady supply of gas, they would be entirely satisfied with the present rates as they had made a careful test and found that through a meter they were using less fuel than they had anticipated, and could make money under the present arrangement.

There is hardly a country on the face of the globe that does not produce its samples of asbestos, and in newspapers, from time to time, we see items concerning this and that fibre which has been found, all of which is stated to be very fine, but which upon investigation proves to be worthless to the manufacturer. Good asbestos requires four prime qualities, infusibility,, tensile strength, fineness and elasticity, and if one of these be lacking it is useless in a commercial sense. Australian asbestos, for instance, is very brittle, and cannot be spun or woven. African asbestos lacks the principal requisite, the fire-resisting quality. Russian asbestos, which for a long time was considered worthy of attention, had to be abandoned; and so on, until there are only two varieties which are practical, Italian and the Canadian. These are different in their texture, but each has its uses. The Italian variety has a long coarse fibre, is a greyish brown, and is soapy, while the Canadian consists of fine somewhat elastic fibres in color, varying from almost pure white to greyish and greenish tints, and in length averaging from two to four inches with a soft silky aspect looking very much in fine specimens to floss silk.

At the present time there are over one-hundred varieties of goods made from asbestos; twelve years ago there were no more than four, and twenty-five years ago it was a curiosity of the laboratory. It is now found in almost every workshop where steam is employed and its use is constantly extending.

MINING NOTES.

[From our own Correspondents.]

Nova Scotia.

Caribou District.

It is reported that the old Lake lode workings are to be unwatered and the high ground on both sides of the deep shaft tested. Rumor has it that a working bond from the owners has been obtained, and that work will begin in July.

The Truro company are confining their operations chiefly to dead work. The main shaft is sinking towards the roll, and some work is doing in the old shaft.

Fifteen Mile Stream.

Reports from miners coming from this district is that a new and high grade vein has been cut and is now being opened. This report lacks confirmation from headquarters, but we hope it is true.

Oldham.

On the night shift on the 13th inst., a large open seam was cut by a shot in the shaft of the Rhode Island Co. on the Dunbrack lode. The water came in very fast, and on Thursday the 15th, the shaft was abandoned until machinery can be erected. The men were put to work on a drive running west, and the management hope to keep the water at that level until pumps get running.

The Columbia Mining Co. have re-arranged their stamping machinery under the direction of L. J. O'Shaughnessy, formerly with the Oldham Gold Co., and better results are confidently expected. Mr. Stephen has replaced Mr. Whidden as the foreman of the company.

The Standard Gold Co., (Taylor & Hurdman), are sinking a shaft upon a new lode called the "McDonell." The shaft is now down over 40 feet and shows a seven or eight inch quartz vein carrying copper, galena and gold.

Stormont.

The North Star Co. have found a new lode on the western end of their property, which promises to become a high grade producer. The vein, when cut, was about two inches thick, and the first bucketful of quartz raised was pronounced 40 oz. rock. Later advices say that the lode resembles the old North Star lode in tts palmy days, some spots being very rich, others poorer, but the whole making a high grade rock.

The Richardson Co. now have twenty stamps pounding, and expect a large bar for June. The quartz continues to yield from 7 to 10 dwts. per ton, and bids fair to be the largest producer of the province for 1893.

Renfrew.

Rumor has it that D. A. Macdonald, (known familiarly as "Chummy,") has uncovered some pay quartz on the old New Haven property. Mr. Macdonald is prospecting the property for a Pictou organization, and is confident of success.

Mt. Uniacke.

A new ten stamp mill is to be built on the property owned by Curren, Prince and others, formerly the British and Colonial Co.'s ground. It will be built near the mill torn down by John Nicholls, and is designed to thoroughly test the ground abandoned by Capt. Nicholls. M. Thos. Prince is in charge.

Mooseland.

During the past year much good work has been done at Mooseland on the property of the Mooseland Gold Mining Co., Ltd., under the direction of H. G. Stemshorn. In the eleven months ending May 31st, about 580 ozs. have been won, principally from quartz obtained in opening up the mine. The main shaft has been sunk 112 feet and levels driven to the east and west for 100 feet each way. The pay chute runs easterly and is cut by the east level. But little stoping has been done, leaving a considerable body of reserves available. The mine has paid all expenses of development and has something to the good. The company is to be congratulated on the success with which Mr. Stemshorn has managed the property.

Ontario.

The Mutual Gas Company, of Port Colborne, Ont., which supplies the Erie Glass Company with gas for manufacturing purposes, and supplies many local consumers, found last winter that it was unable to meet the demand, owing to the large drain made by the glass works. It therefore decided to put down a new well to get an adequate supply. The attempt was looked forward to with much eagerness by the Provincial and the Erie County companies, who supply Buffalo with gas. The result has been a great disappointment. The well has proved a failure. The drill was pulled at a depth of 854 feet, having pierced the second gas sand into the red shale.

Mr. J. R. Gordon, C.E., superintendent of the Creighton Gold Mining Co., (Ltd.), operating in the Sudbury district, was in Ottawa the other day, attending a meeting of the directors of his company. He reported that good progress was being made with the work of opening up the company's mines; the machinery installed gave good satisfaction, and the construction of the mill was well advanced. About 20 men were employed.

North-West Territory.

"We learn," says the Calgary *Herald*, "from a reliable source that a considerable move in mining in the Alberta slope of the Rockies is likely to take place shortly. Competent mining men assert that Alberta is quite as rich in minerals as British Columbia. The only reason why our resources in this direction have not been developed seems to be that they have never been brought before the notice of capitalists. Efforts are now being made to call the attention of those interested in mining matters to the field which Alberta offers to enterprise and capital in the development of her mineral wealth, which will in all probability stir up our long neglected mining interests considerably in the near future."

British Columbia.

The New Vancouver Coal Co. made its "record" day's output on the 30th May, when the yield was 2,300 tons. It is expected that even these figures will be beaten, when the Protection Island shaft is in full working order and No. 5 shaft is again opened.

The New Vancouver Coal Company is still carrying forward its very desirable scheme of providing of five acre homesteads for its workers, on easy instalment terms of purchase. Roads are now being built and a large area of land laid out for this purpose at Starks' Crossing, about 8 miles South of Nanaimo, near the No. 5 mine shaft, and on the line of the Island Railway.

The Kanaka Bar Gold Dredging Co., of which notice of incorporation appears in our companies column, intend by means of a patent centrifugal pump, to seek the gold lying under the waters of the Fraser River, for a distance of some three miles at Kanaka Bar, in the neighborhood of Lytton, B.C. The pump to be used will, it is said, suck up 200 tons of river bottom daily, catching up with other matter the particles of gold underlying the stream. The company thus hopes to make excellent money returns upon the capital investment, which the undertaking involves. Dr. Dawson, (Geological and Natural History Survey of Canada,) gives the data upon which the company bases its hopes of success, in the following passage: "Gold has been gradually concentrated in the river bottom by the action of the stream, while in many places paying deposits have been left upon the surfaces of 'benches' at various levels. Thus when the work of 1858 and 1859. began, the miners obtained with comparative ease and in a short time a large quantity of gold. How much gold has been obtained from the Fraser it is impossible to ascertain, but it may be stated that practically the entire output of the Province for 1857 and 1858 with the greater portion of 1859 was derived from this river, and by far the larger portion from that part of the Fraser extending from Hope to Quesnelle. The aggregate yield for these early years alone can not be placed at less than $1.700,000. The mode of working these gold deposits was comparatively a simple one. Then so-called 'bars' were nothing more than portions of the riverbed, which being left bare at low water could be reached by the miner. They varied in richness not only in different parts of the length of the river, but also in correspondence with the local relation of the current and set of the stream. They were worked generally to a very low limited depth, being often merely shinned over in consequence of the trouble from water, most of the work was accomplished with the primitive rocker. In the bed of the river itself at each season of flood a

partial rearrangement of material occurs, and additional supplies of gold are brought in by the wearing away of the banks."

More particularly referring to that portion of the river that the Kanaka Bar Gold Dredging Company intends to dredge, Dr. Dawson, after referring to the fineness of the gold up to Yale: "From a point on the river, about 16 miles above Yale to Cisco Flat, a short way below Lytton, a distance of 25 miles, rich deposits of 'heavy' gold were worked." In this 25 miles, are included the 3 miles leased by the Company, and, as in the case of Hill's Bar, referred to by Dr. Dawson, as having produced $2,000,000 worth of gold in less than 1-2 square mile, the Company's 3 miles commence at the food of a very rapid portion of the Fraser, where the river first frees itself from the canyon, and expands to a greater width with a slacker current over the Kanaka Bar, inducing the belief that for centuries gold has been washing through this gigantic ground sluice, the quantities on the Bar, now the Companys' leasehold. Those interested the Company are sanguine of complete success, which it is to be hoped they may achieve by their somewhat novel, yet apparently thoroughly practical method of river gold mining."

The question of sampling works for Kaslo is practically settled and the Boston and Montana Mining and Smelting Company has deposited through its agent, C. H. Bartlett, $1,500 with the Kaslo Townsite Company as a guarantee for the completion of the works within four months. The capacity of the plant will be 100 tons daily and all the machinery will be of the latest and most improved pattern. The plans call for a three story building to be built in a substantial manner. The ore will be delivered to a Blake crusher on the third floor and go from there to a Gates crusher on the second floor, after which it is quartered and then ground down and parted until the quantity is reduced to proper quantity for assaying.

According to the *Outlook* the Columbia mine on Mineral Hill in the Okanogan country is one of the most promising looking properties in that section and it appears as if the owners intended to do some systematic and extensive development on the property. Since the return of E. P. Wheeler from Bridgeport, Conn., where the major portion of the stock is held, he has been busy. A wagon road is being graded from the old shaft house to the new workings, about 200 feet further up the hill, where Mr. Wheeler took out and shipped four tons of ore to Omaha which milled 146 ounces in silver, 22 per cent. lead, 15 per cent. copper and $8 in gold to the ton, which would at this time mean a total value per ton of $180. So far, three veins have been found on the property, and being within a space of fifty feet it will be surprising if they do not run together at no great depth and thus form one great ore body. Two of these veins are eighteen inches and one a foot wide, all ore of high grade. As indicative of the confidence which the owners have of the quality of their property they are buying up as many of the adjoining claims as they can, having secured a two-thirds interest in the Buck Horn, all of the Franklin Boy, and a quarter interest in the Eureka claim, which last named property is owned by Nelson Clark of Spokane Two Bridgeport (Conn.) capitalists, Messrs. Horace Pigg and Dr. May, have purchased 50,000 shares of the company's capital stock from J. L. Spath and with Mr. Rodgers, one of the other large stockholders, these gentlemen will visit the property this season to determine upon the nature and extent of development to be done. The stock is now all held by wealthy men who will thoroughly test the ground and when convinced of the extent and value of the ore bodies will push the work vigorously day and night, erect a concentrator and put up substantial buildings for the accommodation of the large force of men to be put to work. With men of the capital and enterprise of those composing the Bridgeport Mining and Milling Company the Okanogan is sure to be an active district this season and we trust that many rich ore bodies will be exposed in addition to those already uncovered.

(From the Nelson *Tribune*.)

Ainsworth keeps forging ahead, and to-day it is one of the most active camps in the district in development work. A very significant fact about the camp is that railway men are becoming active in pushing its claims to the front and making investments in it. Railway men, above all others, know a good thing when they see it. J. V. Carroll, of the Baltimore & Ohio railway, was here about ten days ago, and went over it very carefully, examining many prospects, and as a result he has bonded two claims for a mining company of which he is the president, and made arrangements with Messrs. Strobeck & Hardy to build a wagon road from the end of the present Cedar Creek road to his claims (about 3000 feet) for $1000. W. R. Busenback, general traffic manager of the Chicago & Great Western railway has purchased an interest in the Spokane and Trinket, and is expected daily in the camp to meet John A. Wolgamo, the chief owner of these two claims. They will proceed at once to sink the present shaft in the Spokane fifty feet, and when that is completed they will put in a boiler and engine and the necessary machinery for further sinking. They will also do some tunnelling.

Manager Johnson of the Schaffer company is knocking out six feet a day in the big tunnel, and is running night and day. So strong has his faith become in the value of the camp that he has bonded several claims and has gone to Seattle to induce his friends to buy and develop them.

The Highland has the call at present on everything in the camp, and to the average denizen of Ainsworth it is his pride to speak of it. Less than a month ago it was spoken of as a fair average prospect, but Messrs. Stevenson & Mikel have in that time worked a complete transformation. They have run two tunnels; one on the lower and larger ledge, the other on the upper and slightly smaller ledge. Besides this tunnel work they have sunk three shafts on three different veins running from these ledges and cutting the formation. They have 150 tons of ore on the dump ready for shipment as soon as the wagon road to the Cedar Creek bridge is completed. In the lower tunnel, they struck a large body of high-grade ore at thirty feet from the mouth. The ledge in the tunnel is eight feet wide; the vein is about five feet with a solid ore body of nearly three feet in width, and will assay 150 ounces silver to the ton. This has been done with an expenditure of less than $1500, and a prospect has been thus raised to the dignity of a mine. This experiment has shown what can easily be done with many other prospects in the camp when gumption and grit characterize the men in the enterprise.

CANADIAN COMPANIES.

The Kanaka Bar Gold Dredging Company, Ltd., with a capital of $50,000 in shares of $10.00 is seeking charter of incorporation under the laws of British Columbia, with the object of purchasing and acquiring the rights, concessions and privileges owned by Thos. J. Beatty, C. S. Bailey, W. H. Gallagher, and H. G. Neelands, known as the Kanaka Bar Driving and Dredging Company, by virtue of an indenture dated 31st Jan., 1890, and made between Frederick Hussey, as Gold Commissioner, and the said parties as licensees; also to carry on the business of miners, submarine or otherwise, and to win, get, mine and work ores, minerals, metallic substances and precious metals of all kinds. Directors; Robert A. Anderson, W. H. Goodwin and Charles S. Bailey, all of Vancouver, B.C. The Head Office of the company will be at Vancouver, B.C.

The Prince Albert Flat Hydraulic Mining Company, Ltd., is also seeking charter under the laws of British Columbia. Authorized capital, $200,000, in shares of $1. Head Office, Vancouver, B.C. Directors, George D. Scott, W. J. McGunigan and Albert H. McNeill of Vancouver, B.C. Formed to take over and acquire mining leases of lands or claims in the Province of British Columbia, and to acquire all the rights and interest of all parties interested in such lands; to carry on the business of hydraulic processes of mining, &c.

Quesnelle Forks Canal aud Hydraulic Mining Company, Ltd., is the name of another new British Columbia Company formed to take over and operate certain water rights, and for bringing a ditch or canal to the bench lands in the neighborhood of the North and South Forks of the Quesnelle River, Cariboo District, in the Province of British Columbia; also to acquire mining leases of the company is authorized to carry on, or any business or transaction capable of being conducted so as directly or indirectly to benefit this Company, and to take or otherwise acquire and hold shares or stock in or securities of, and to subsidize or otherwise assist any such company, and to sell, hold, re-issue, with or without guarantee, or otherwise deal with such shares or securities, &c. Capital, $300,000, in shares of $100. Directors, J. Loewan, W. P. Sayward, C. N. Gowan, Wm. Wilson and Frank S. Barnard. Head Office, Victoria, B.C.

Bridge River Gold Mining Company, Ltd., has been formed in British Columbia, with a capital of $25,000, in shares of $100, to carry on the business of smelters, refiners. founders, assayers, dealers in bullion, metals and products of smelting of every nature and description; to carry on the business of buyers and sellers of and dealers in all kinds of ores, minerals, gold dust, mineral substances and compounds, coal, timber, logs, lumber produce and merchandise of every description, negotiable paper, securities for money, and to do all kinds of commercial business, except banking and insurance; to carry on the business of miners of every description, and to procure by purchase or otherwise, mine and work, mining locations, mines, ores, minerals, gold dust and all other metallic substances and compounds of all kinds, &c. Directors, George E. Bower, John Leatherdale, W. G. Allen, J. A. Russell and Finlay R. M. Russell, all of Vancouver. Head Office, Vancouver, B.C.

The Bothwell and London Crude Oil Company, Ltd., has applied for charter in Ontario for the purpose of purchasing, acquiring by lease or otherwise lands in the County of Kent and boring, digging and constructing petroleum and oil wells and pumping thereof, and the storing, tanking, refining and dealing in petroleum oil and oil wells, etc. Capital, $20,000, in shares of $10. Directors, W. T. Strong, J. D. Wilson, H. R. Abbott, P. W. D. Broderick and G. A. McGillivray. Head Office, Bothwell, Ont.

Kootenai Hydraulic Placer Mining Company.—This company has 15 or 20 miles of claims, extending some distance back from the banks of the Pend Oreille River. The ditch has been completed, and the water will be turned on the gravel very shortly. The flume is 18 miles long, and is said to have cost $75,000.

North American Mining Company.—The annual meeting was held in Montreal, May 15th, and resulted in the election of G. N. Ducharme, F. Bayard, A. Montreuil, A. Renaud, A. Yale, A. Bayard and O. Henault as directors. At a subsequent meeting of the directors G. N. Ducharme was elected president and A. Bayard vice-president.

The Boston and Nova Scotia Coal Company.—At a meeting of this new organization held this month in Halifax the following officers were elected:—President, Hon. John Chandler, Boston; Vice-President, John McKeen, Mabou, C.B.; Treasurer, W. J. Fraser, Mabou, C.B.; Secretary, A. C. Ross, North Sydney, C.B.; Directors, David S. Baker, John C. Cobb and R. P. Fraser. The several properties at Broad Cove, Cape Breton which have been under offer to the company were taken over and their development was decided upon.

New Vancouver Coal Mining and Land Company, Ltd.—In their report for the half-year ended December last the directors of the New Vancouver Coal Mining and Land Company, Limited, state that the net output for the half-year was 195,318 tons, and the sales were 197,537 tons. "There was a slight improvement in prices as compared with the former half-year, but the market has, on the whole, continued dull. At the present time our agents report the outlook as a little more encouraging. A reference to the accounts will show that a net profit of £3,097 5s. 10d. was made during the half-year, but, as considerable amounts have in the course of the half-year been expended on capital account, the actual financial position has not improved; this fact, the prospective requirements of the company in respect of bunkers, and the payment for electric haulage in the East Field mine, preclude the payment of a dividend for the half-year." It is proposed in future to hold only annual meetings, although half-yearly accounts will be sent to the shareholders.

History of Tin.*

TRANSLATED FROM THE WORK OF E. REVER BY BRENTON SYMONS, M. INST., C.E.

In ancient Hindu tin was called *Naga*, in Persia *Aonya*, in Hebrew *Anak*, and in Ethiopian *Naak*. The similarity of these diverse appellations proves that this metal proceeded from the same centre of production, presumedly, the inexhaustible stream works of the East Indies. There can be little hesitation in believing that here originated the name by which it was afterwards known throughout Asia and the east of Africa. Besides these very old names, from a thousand years before Christ to the early centuries which followed his advent, the term *Kassiteros* was habitually used in the countries which bordered the Mediterranean Sea; Homer knew it by this name, as did also the Romans. Where tin first received this designation is yet unknown, but it is far from improbable that the Phœnicians, who during this period controlled the world's commerce, extended its use afar; they were merchants or pirates, according to circumstances, and exchanged the treasures of Europe for those of Asia. From time to time they made voyages to Spain and England in search of the metal, and it thus appears likely that it was the Phœnicians themselves who introduced the term Kassiteros to the Indies. However this may be, it is certain that in the last centuries preceding Christ, this name was found in the Hindu writings corrupted to *Kastira*, whilst anteriorly it was always the native term *Naga* that was employed.

The tin from the Indies was, without question, the most important for commerce in olden times, and the quantity of this metal absorbed by the civilized states of Asia in the preparation of bronze must have been very considerable. China supplied herself partly from the same source, but also from the mines which she possessed in the provinces bordering on the Indies. The Chinese bronze industry flourished between 1800 and 1500 B.C. and between 1100 and 900 B.C.; that of the Indies was not more ancient. Money, vases, bells, mirrors, and other objects of art were manufactured in such large quantities, and the employment of tin for plating kitchen utensils was so general, that one may reasonably conclude that the production of that metal was colossal. Probably at this time Europe consumed only English and Spanish tin, and as the uses for it were very limited, the industry was in an almost barbarous state.

It is to be regretted that no statistics with respect to the production of tin in the Indies at those remote periods are available, and with respect to Europe the following paragraphs contain about all the information which has reached modern times. As has been already remarked, the Phœnicians, who possessed the commerce of Europe, obtained tin from Spain and England. Their principal entrepot was the town of Cadiz in Spain, which, founded about 1000 B.C., had rapidly acquired a great importance.

* Transactions Mining Institute of Cornwall.

They must also have supplied Egypt with tin, because this old civilization possessed neither mining industry nor commerce. The metals which Egypt absorbed were, from the most remote times, furnished by Asiatic merchants, and it was only during the earlier centuries after the Christian era that the Egyptians began to have—through the Red Sea—direct relations with the Indies. The early Christian centuries were contemporaneous with the prosperity of the Ethiopian Empire, and trade relations were therefore commenced and continued through the intermediation of this people. The Arabs interested themselves in the tin trade subsequently. The Abyssinians used the Hindu word *Naak*, whilst the Arabs used the Mediterranean term *Kestir*. After the conquest of Spain by the Romans, the Phœnicians lost the tin trade.

Concurrently with Spain, one of the principal producers of tin was England: Cæsar speaks of the "white-lead" that was imported from England and Diodorus recounts that the Britons found the ore in the stones. The smelted metal was transported in bars by way of Nectis (the Isle of Wight) across Gaul, on the backs of horses, to Rome. Marseilles became the Roman emporium and rapidly grew to the same importance that Cadiz enjoyed the Phœnicians. The metal was almost exclusively consumed in plating copper for the manufacture of vases, casks, etc., and occasionally for minting. The alloys of tin and copper were used to cast statues, to make weapons, mirrors and coins. There seems every reason to believe that anciently alloys were not obtained by the mixture of the metals themselves, but by the simultaneous metallurgical treatment of the two minerals. They probably smelted copper pyrites with stamped tin ore, just as they produced zinc bronze by smelting calamine with tin ore.

As a proof that the tin of Spain was, during the dawn of the Christian era, dominated by that of Cornwall, it may be recorded, that instead of the Latin term *plumbum album*, the galic word *Istean*, or *Stean* in Cornish, became prevalent. The names zinn, tin, étain, are of similar derivation.

Marseilles became a flourishing commercial town and even added a new branch of industry—that of casting bells. The ancient Hindu custom of using bells soon extended to Byzantium, and in the tenth century had already reached Italy, where it was applied to the services of the Christian religion. Later on, the use of bells increased more and more, until villages, as well as convents, took a pride in possessing the largest. (The first large church bell was founded in the Campagne hence the Latin word *campana*.)

The great increase of this industry favors the supposition that the production of, and commerce in tin, received a remarkable impulse during the middle ages. Gradually Marseilles was dispossessed of the tin trade by other commercial emporiums. Cologne had already business relations with England at the time of William the Conqueror, and during the twelfth and thirteenth centuries Bruges acquired the control of the eastern European markets, and consequently of the trade in tin.

At the beginning of the middle ages it would appear that Devonshire may have furnished the greatest amount of tin, from the rich stream-works existing there. About 1200 A.D. the production of the Cornish workings was still inferior to that of its sister county, but in the centuries immediately succeeding, the production of the mines of Cornwall surpassed that of the stream-works of Devonshire; the former county has preserved its supremacy to the present day, whilst the stream-works of the latter have become successively exhausted and now give to commerce but insignificant quantities.

Towards 1300 A.D. the miners and smelters of Cornwall ceded to the lord of the soil as royalty, about 40% of the raw produce, in 1480 they yielded up 20% to the lord and 20% to the occupier of the land, in 1750 6% to the lord and 11% to the occupier whilst in 1830 the royalty diminished to 4½% to the lord and 6% to the surface proprietor.

During the latter part of the middle ages, the tin pigs were exported to Bruges, to which place the Italian and German dealers came to purchase them. The ordinary route by which the tin was exported, was by land towards Italy, but from the beginning of the fourteenth century, half the bulk was transported by sea in Italian bottoms, which then supplied the coasts of the Mediterranean and particularly the East (Constantinople, Alexandria, etc.)

It was about this time that tin, produced from the mines of Granpen in Bohemia, began to appear in the Continental markets, and it may be conceded that English tin was, to a very considerable extent, replaced throughout Germany by its youthful rival. The mines of Granpen have been known since the twelfth century, and during the thirteenth, Schonfield, another mining district in Bohemia, also produced much tin, and it is probable that Cologne—which at that epoch was possessed of the Bohemian trade—threw a large aggregate of tin from these mines on the market. The mines of Granpen and Schonfield produeed abundantly during the whole of the fourteenth century, and the tin not exported in bars to Germany was consumed in the country itself. At the Teinhof works in Prague they employed experienced smelters from Venice and Lombardy. The principal objects manufactured were table services, and untensils for religious ceremonies. Towards the conclusion of the middle ages, the production of tin must have considerably augmented, on account of the general practice of making bronze cannons, and because the use of tin for table services was common amongst the people of Italy and Germany.

During the first half of the sixteenth century so much capital was engaged in the opening of numerous mines in Bohemia, that the production of tin was soon much increased. The Attenberg mines were working during the latter half of the sixteenth century, and during the first ten years its washings returned 500 to 750 tons of tin annually. The ancient mines of Granpen, Schonfield, Schlackenwald, Ehrenfriedersdorf, and Geyer, have been re-worked several times, and new washings installed at Eibenstock, Platten, Gottesgab, Abertam, Hengstererben, &e. Very soon afterwards, mines were also opened in various places in these districts. About 1546 A.D. twelve dressing floors were put up at Platten for the treatment of the tin ores, and at the same period the districts of Attenberg and Ehrenfriedersdorf in Saxony were conspicuous as tin producers.

The mineralized rock, or tinstone, was everywhere extracted in Bohemia and Saxony by the aid of wedges and by fire. Towards the termination of the fifteenth century the ores were still crushed in mortars and hand-mills, and the resulting pulp washed on frames. Stamps did not appear until the earliest years of the sixteenth century; the concentration was made on sleeping tables and in slime pits; the slimes were roasted and the impure tin was subjected to liquation.

In the sixteenth century the Italians invented new ways for the application of tin, viz:—tin-leaf was employed to coat mirrors, and to glaze majolica and cooking utensils, and to enamel iron. Then, very soon, tin became indispensable to the dye-houses, on account of the discovery of the valuable properties of its salts as a mordant. Libavius first made tin chloride, but it was Dribble who first discovered, by accident, its value for fixing dyes, and the use of this important mordant speedily extended to Germany, England and France.

The early years of the seventeenth century are of great importance in the history of tin. In Bohemia and Saxony, the mining districts of Schlackenwald, Platen, and Altenberg, produced tin abundantly until the outbreak of the thirty years war, which caused the suspension of all the mines for at least fifty years. At the same epoch the miners in Cornwall worked only four hours a day, and broke all the ore by use of the wedge. In Bohemia and Saxony the science of mining was more advanced, and some German workmen who were invited to England, much improved the method of draining the mines, breaking the ores, and smelting them. Becher instructed the Cornish smelters how to reduce the tin ore in reverberatory furnaces with charcoal, and the improvements made had a sensible influence on the English production. During the thirty years war the English tin industry gained what that of Germany lost. The Indies and China continued to produce and to absorb immense quantities of tin. The Dutch, who in the seventeenth century repulsed the Spaniards and Portuguese from the East Indies, seized on a portion of the tin trade. Despite the great increase in the production of English tin, it must be admitted, that even early in the seventeenth century, the aggregate production of the civilized countries of Asia exceeded ten times that of Europe. During the eighteenth century the returns of tin from Bohemia and Saxony were much increased, and the trade continued in a flourishing condition, but modern times have seen the closing of nearly all the tin mines in the centre of Europe.

Towards the middle of the present century the system of contract (tutwork and tribute) was generally adopted.

The Newcomen steam engine replaced the horse engines and water wheels for the drainage of the mines, but between 1770 and 1780, these engines gave place to those of Watt. At the end of the eighteenth century, Cornwall sold more than 3000 tons of tin annually. In 1828 stamps were first used in that county. Near 1800 A.D. Siam and Malacca produced about 1500 tons yearly, and Junk, in Ceylon added 200 to 500 annually. From 1820 to 1860, Malacca sold about 2000 tons, but from 1860 to 1870 the production was much increased.

The first man-engine was laid dawn in Cornwall in 1842, and in the same year round buddles came into use. In 1840 the tin ore was relieved of its impurities, and the produee raised, by treating it with hydrochloric acid.

Beginning from the end of the last century, the proportion of copper ore in the Cornish mines, increased with the depth, but from 1850, on the contrary, the percentage of tin ore has again increased. The production of tin since then has been about 8000 tons yearly. Between 1850 and 1860 trommels were introduced in the Schlackenwald district, for the elassifying of the "roughs," and the slimes were roasted with salt. In England they followed the same method in certain mines. In 1858 tungstenic ores were first treated by Dr. Oxland (at Drakewalls mine)with soda, and the wolfram transformed into tungstate of soda, was sold as a by-product. This salt i employed in dyeing, and for the impregnation of substanees to be made fireproof.

Banca produced, during the last century, more than 3000 tons of tin, but during the early decades of the present, this decreased by one-half. In 1850 it attained its maximum output—5000 tons yearly. After 1860 the production fell to 1000 tons, but this amount inereased to about 4000 tons after 1870. Between 1850 and 1880, Peru, Chili, Bolivia and Java, have each exported from 50 to 200 tons of tin annually to England. In the United States, tin ore has been found in many localities, but up to now rarely in workable quantity. Since 1853 tin has been produced in Victoria and New South Wales, and in Tasmania since 1872. Important improvements in the preparation of the ores have been lately introduced in Australia. Long droughts compel the mines to establish numerous reservoirs, and to employ with the utmost economy the storage water. The European workmen have been pushed aside by the heathen Chinee to such an extent, that the government, to place a limit on the Chinese immigration, has established a heavy poll-tax. The production in Australia, between 1874 and 1877, was from 10,000 to 15,000 tons annually.

The uses of tin have considerably multiplied and grown during the past 200 years. From 1700 A.D. tin has been widely applied in Bohemia and Saxony to the plating of iron. Agricola was aware of the method of coating iron with tin, though, in his time, little use was made of the knowledge. Plating was introduced into England in 1670, and afterwards into France. But both before and after the invention of plating, numerous articles of commerce were manufactured exclusively from tin, and this branch of the trade was developed in an extraordinary manner during the eighteenth century in Germany, France and England. Salmon describes, in his splendid volume on tin smelting, the methods of working, and the objects manufaetured, and in his woodcuts, we find table services, knives and fork, jugs, candelabra, lamps, chemical and surgical instruments, boilers, etc., in the most varied forms. There existed in England in the last, and even in the present, century, a crowd of miserable little tin workshops, many of a very inferior class, whieh were occupied in the making of tin ware, and in the plating of copper and iron goods. It is only during the last three or four decades that the spirit of enterprise influenced capitalists to embark in this kind of industry. Between 1840 and 1850 A.D. Griffith perfected the manufacture of tinned utensils in one piece, and this branch of the trade was especially developed in France, between 1850 and 1860 A.D. Instead of compression by a blow, which caused much waste, a slow continuous pressure was applied. Since then, pressed articles in plated iron have overcome all competition, as they unite the strength and cheapness of iron with the valuable properties of tin. The United States sustained the competition successfully by contriving in 1866, a method of manufacturing impermeable boxes from a single piece without soldering. England has, for a long time, produced large quantities of tin plates, and two-thirds of its colossal production have been exported, most of which between 1850 and 1860 found a market in the United States.

An interesting detail in the history of tin is the recovery of that metal from the waste. In the workshops using tin plates, and notably in those making cans and buttons, six per cent. of loss occurs. Many attempts, more or less successful, have been made to recover this loss. Schmuck in 1848 patented various methods. In 1854, Higgins obtained a patent for the following way: solution in hydroehloric acid (with a little saltpetre) and precipitation by means of lime. Phillip's process for purifying the tin of Peru was employed later to extraet tin from tin-plate cuttings, viz:—the impure metal was granulated, and dissolved in hydrochloric acid, then, provided the tin was in excess, the wolfram, antimony, and arsenic, up to five or ten per cent. would not be attacked; the tin was deposited on zinc plates, and the zinc thus placed in solution was precipitated in the form of white zinc, hy the addition of milk of lime. Jacobson used soda lye, and Parks concentrated sulphuric aeid, to put the tin in solution, and the salt obtained was in each case employed in dyeing. Kunzel boiled the tin plate clippings in water acidulated by nitrie acid; the tin was then thrown down by zinc, dissolved in hydrochloric acid, and the resulting salt was sold as a mordant; he treated in this manner, during 1869, over 400 tons of waste obtained from the manufacturers of canned preserves at Nantes and Paris. This method is somewhat varied by substituting for liquid hydrochloric acid the same acid in a gaseous state.

Tin is used for the preparation of phosphor bronze. In the fusion of that alloy, the absorption of oxygen is very prejudical to its quality, the formation of oxidulated tin rendering the alloy brittle. Formerly they endeavored to hinder oxidation by stirring the mass with wood, or by adding a little zinc, but for the last dozen years this object has been much more efficaciously attained by the addition of a little phosphorus: this augments in a remarkable degree, the compactness, resistance and elasticity of the product, besides giving it a beautiful golden color. Cannons, statues, ornaments, bearings, etc., are cast in phosphor bronze with the greatest success, and the sale is day by day increasing.

If we combine the information relative to the production of tin, we obtain the following resume (1881):

Australia	10,000—15,000
England	10,000
Straits, Malacca, etc	10,000
Banaca and Billiton	7,000—9,000
Tasmania	3,000—5,000
China	5,000

or for the whole world, say, from 40,000 to 50,000 tons annually.

The largest consumers of tin are China, the East, United States, England and France. The most important use in Asia is for plating copper, whilst in Europe and America, tin is almost solely employed in the tin-plate trade; the manufaeture of bronze and white metal, absorbing in comparison, only feeble quantities.

Testing Station for Explosives at the Produits Collieries, Flenu, Belgium.*

The object of this testing station—due to the manager and underground manager of the Produits Colliery, and to the managing director of the Clermont Powder Mills

*From *Explosifs de Surete*, by A. Macquet, director of the Hainault School of Mines.

and the Matagne Dynamite Factory, Liége—is to prove that under identical conditions, the various explosives now used in mining, are far from affording the same guarantees of security; to compare them one with another, in order to find out which is the safest and which are unsafe; to determine whether these guarantees persist under the most dangerous conditions; and, lastly, to recommend, to those engaged in mining, an explosive absolutely safe in the most unfavourable cases, where prudence may be conspicuous by its absence; as well as to afford the opportunity, to all interested in the subject, of judging for themselves as to the correctness of the results obtained.

The Produits Testing Station was laid down on the plan of that at Neunkirchen, with the modifications dictated by experience, or the desire to reproduce as faithfully as possible the dangers actually encountered in underground workings; and as a study of the part played by coal dust did not enter into the question, but only a comparison of the explosives themselves, it was possible to simplify the arrangements.

The French Firedamp Commission practically lays down as a principle that, to make absolutely sure of the degree of safety which may be depended upon in a given explosive, it must be tested by explosion in the open air, and under the most favourable conditions for incomplete explosion, because "it may always happen accidentally, through the imprudence or inattention of a miner, or other cause, that the explosion of substances employed in the underground workings may be determined before they are safely charged into the bottom of a shot-hole," and that "the danger presented by explosion in the open air is therefore not purely imaginary." The accident which would provoke explosion in the open air "is doubtless very difficult to imagine, but it is not quite impossible, and should be provided against."

These protestations against foreseen objections are not convincing. Given an explosive which requires the violent effect of a detonator to explode, it is difficult to imagine how it can be accidently exposed to so energetic a shock in underground workings. The French regulations require that explosives be always kept in a safe place, protected from accident. They are to be shut up in boxes, in such a manner that a fall of the roof would be powerless to explode them, the detonators being kept separate from the explosives. The following is the text of the Belgian regulations on the subject:—

Art. 53—"Powder, dynamite and detonators must be isolated from one another and kept in separate bags or boxes."

Art. 56—"Up to the time of using them the cartridges and fuses intended for blasting are to be deposited in a safe place, to be chosen by the chief miner."

As to imagine the deliberate use of explosives not charged into a shot-hole, but simply placed on an obstacle to be shattered, where has such a risk ever been run at defiance of the most ordinary dictates of common sense; where could such waste take place, in any case and under any pretext? If there were reason to fear the explosion of a substance through fall of the roof, measures of safety would be sought rather in requiring a minimum of resistance to shock than a minimum of explosion temperature. In fact, on account of the complexity and the slight stability of the phenomena which may take place during explosion in the open air, one can never be sure that a method of incomplete explosion, unforeseen and not tried in experiments calculated to establish the safety of an explosive, may not occur at any time.

One of the constituents of the explosive may (as acknowledged by the French Commission) on account of imperfect mixture, explode separately on the surface of the cartridge, and this element might be that of the two capable of giving out dangerous flames. It should not, however, be assigned a too high value, as that might induce another danger. The men, knowing that they had to deal with a resisting (stable) explosive, might be imprudent in the stemming, while the inventors, knowing that their explosive requires a strong tamping in order to act effectually, might go so far as to advise that stemming be performed with the hammer, in defiance of all thought of prudence; and the shot might be fired during the stemming. It is for these reasons that no arrangements have been made at the Produits Testing Station for causing explosions in the open air.

What are the most dangerous conditions of explosion that may be met with in practical mining? To realize something similar in our boiler," says the French Commission, at page 71 of its *Report*, "in the case of a shot which is not blown out, but under conditions certainly more dangerous than any which may happen in practice, we suspended, so as to be surrounded by firedamp, the explosives enclosed in a metal tube (lead or tin) closed at bottom and open at top. In this tube the explosive rested on 5 cm. to 6 cm. (2 in. to 2⅜ in.) of clay or sand, and was covered by a tamping of clay, sand, or even, in some cases, coaldust 10 cm. to 12 cm. (4 in. to 4¾ in.) thick. The explosion burst, and projected in the state of dust, that portion of the tube where the explosion occurred. the upper and lower portions generally remaining intact at the bottom of the boiler. The nature of the metal, and especially its thickness, might be varied; but no observations have been made in this connection, nor was there any interest in making them, except in the case of explosives which ignite firedamp in the open air.

As the tube burst, the hot gases certainly came more immediately into contact with the surrounding explosive atmosphere than in the case of a shot which does its work; and they are so much the hotter as the energy taken up by the bursting of the tube is less. The tubes used by the French Commission required an expenditure of dynamic force equal, on an average, to one-third the total energy of the explosive; and the force of shocks in rock is much greater. But the danger of these artificial cases is far from equalling that of a blown-out shot, all the hot gases of which are impelled forward in one direction, and at a high temperature, the work accomplished being insignificant as compared with the total effort of the charge. It is evident that the conditions are in the highest degree dangerous if the shot be blown out while it is being tamped, and still more so if this occur while the charge is being inserted. Several accidents of this kind have happened. A shock given to the detonator while the cartridges are being placed in the hole, or while the charge is being withdrawn in the case of a mis-fire, may occasion ignition while the explosive is not covered by any tamping; and these are evidently the most unfavourable circumstances.

In the Produits Testing Station, attention was only turned to reproduce, easily and without danger, an unlimited number of blown-out shots; and it was with this view that the testing station was established in a large open space, surrounded by walls, behind the surface buildings of pit No. 25, at Flénu. The shot-hole was reproduced by a Krupp cannon of crucible mild steel, measuring 55 mm. (2⅛ in.) calibre and 58 cm. (23 in.) deep, the metal being 172 mm. (6¾ in.) thick, which corresponds with an external diameter of 50 cm. (20 in.); the outside length of the breech is 70 cm. (20 in.), leaving 20 cm. (8 in.) for the thickness of steel at the breech end.

The mine drift or heading is represented by an old boiler 1·5 m. (5 ft.) in diameter, and 10·9 m (36 ft.) long. One end is open and the other closed, over a length of 30 cm. (12 in.), by a solid mass of masonry in which the cannon is laid parallel with the boiler, but 20 cm. (8 in.) below its centre line. The cannon is pointed slightly upwards, so that the issuing flames may strike the roof of the "heading" (boiler) at the end of the gas chamber, which stops at 4·55 m. (15 ft.) from the face of the back wall, flush with the muzzle. In this way the flames traverse the mixture of gas and air (which may happen to be not thoroughly mingled) in their most inflammable zones. In order to give greater stability to the "heading" the boiler is sunk 60 cm. (2 ft.) below the ground level; and earth is piled up over the mass of masonry, against which the boiler abuts. Besides, to deaden the effects of recoil, the boiler has been strengthened by connecting it, through an angle-iron, with a heavy ring or collar bedded in the masonry. The outer wall bears on the boiler, projecting by 40 cm. (16 in.) beyond the inner back wall. The apparent length of the "heading" is therefore 10·2 m. (33½ ft.) outside, and 10·6 m. (35 ft.) inside, a trench being made in front of the boiler for taking off the gases and smoke of the explosions. At first, this trench was only 2½ m. long; but gradually its length was increased to 12 m. (39 ft.) for favouring the expansion of the gases. In this manner the effects, in the case of an explosion, were confined as much as possible, while the vacillation of the accompanying flames were facilitated.

The total capacity of the "heading" is 18·73 cubic metres (625 cubic feet); and an impermeable screen stretched transversely 4·55 m. (15 ft.) from the end, serves to isolate from the shot a gas chamber of 8 cubic metres (282½ cubic feet) capacity. The working of the apparatus is very simple, the operation being accomplished in less than a minute. At the right distance a double-channel iron hoop is riveted inside the circumference of the "heading," forming a groove of about 2 cm. (⅛ in.) A sheet of paper soaked in paraffin, the edges of which are bent into the groove, is fixed to it by an elastic bandage, the latter being short enough for its tension to ensure tightness of the joint. The seam between the channel iron and the boiler was also rendered tight by caulking with hemp and red lead, or with metallic lead.

For the explosive gas, lightning gas was used, the apparatus being placed in communication with the gas main supplying the surface buildings of the colliery. A meter in the pipe permits of rapidly introducing the desired proportion of gas; and the gas pipe terminates on a line with the cannon and 50 cm. (1 ft. 8 in.) in front of it. To effect a mixture of the gas and air, an agitator is suspended from the roof of the heading, being worked from the outside of a copper wire, the edges of the hole through which the wire passes being rounded off. This stirring is sufficient for the object in view, although it may happen sometimes that the mixture is not quite homogeneous. To exactly fulfil the conditions which occur in practice, it would have been better to have experimented with natural fire-damp; but when this cannot be obtained the author sees no reason why *formene* should be employed, as fire-damp is not pure *formene*. Sometimes the hydrogen which it contains makes it more inflammable than *formene*, while, rendered impure by carbonic anhydride and nitrogen, it loses much of its sensitiveness; besides, it is proved that, with lightning gas of medium composition, mixtures are obtained, the explosibility of which is not less than that of most samples of fire-damp. Moreover, it has been proved that air containing 10½ per cent. of this gas is practically as dangerous as the most explosive.

To introduce dust into the phenomena, two methods were employed. Sometimes form 8 to 10 litres were strewed upon a board within reach of the flame from a shot. The board was laid upon two bricks placed on end, one of its ends resting on the cannon 12 centimetres (5 in.) below the centre line of the hole. With this arrangement the flames only licked the dust near the hole, drove them forward and brought them into a state of suspension in the surrounding atmosphere. Whatever was done and whatever might be the composition and degree of fineness, more or less dust was always floating in the air; and the finer portions remained permanently suspended in the "heading." At other times—for instance, if it was desired to constitute an inflammable atmosphere by the aid of dust alone and without gas—a rag was hung to the agitator so as to drag over the dust on the board. It should also be noted that the draughts due to the working of the agitator were sufficient to raise enough dust. Lastly, to cause clouds of dust outside the scope of the agitator a broom was brought into requisition.

Ample measures were taken for observing what passed inside the "heading" and for avoiding any dangerous effects of a gas explosion. In a casemated chamber which contains the gas-meter and the electric firing apparatus, the charges are prepared. Of course there could be no question of any other than the electrical method of firing, which is the only safe one. The Belgian Firedamp Commission, appointed in 1888, gave preference to induced currents, the sparks which they may produce being easily avoidable, and their drawbacks being less than those of batteries. A static induction machine of Bornhardt or Ebner, with Bornhardt detonators, charged with 0·54 gramme of fulminade, were used for firing; and Nobel detonators, containing a gramme of fulminade No. 5, were exploded by a Scola and Ruggieri contact-maker. The Bornhardt or Nobel detonators were sufficiently to ensure complete detonation, even with grisoutite; and it should be remarked that it is not so important that the detonators contain a large charge as that there be a great density of charging, both as regards the intensity of the shock and the degree of safety.

In researches which have hitherto been made as to the properties of explosive mixtures, with or without coaldust, and of the comparison of various explosives as regards safety, too little attention has been directed to the temperature of the place where the explosion occurs. It is not that there was any doubt as to the influence which this temperature might exert on the explosibility of these mixtures; but no thorough investigations have been made in connection with this subject, so that they still remain to be carried out. Galloway, in a study of the influence exerted by climacteric conditions on firedamp explosions has only considered the question of temperature, so far as variations of the thermometer (in the atmosphere at the surface of the colliery) may be repeated in the underground workings, while causing considerable variations of volume, and outbursts of gas similar to those brought about by barometric fluctuations; but, as regards the influence of the temperature of air-currents in the mine itself, there is scarcely any question. It would appear that the special commissions which have made investigations into mine accidents, and especially as to the danger of explosives, have generally had no other thought than of experimenting under conditions comparable with those of underground workings.

The author remarks that Hall and Clark, in their investigations as to the explosibility of coaldust, arrived at their conclusions only in the case of dry mines at a high temperature. With respect to Sir Frederick Abel's experiments, the author quotes from the report of the English Firedamp Commission as to heating the air, in order to obtain such results as are produced by coaldust in most underground workings where the normal temperature is relatively high. As dry mines are precisely hot mines, and *vice versa*, at any rate generally, he thinks it possible that, in studying the influence of dust on explosions, the effects of dryness of the dust may have been sometimes confounded with those of their temperature.

Herr Wullmer and Herr Lohmann, in their report on the experiments made at the physicial laboratory of the Aix-la-Chapelle University, state that they made no experiments with respect to the relation between the temperature of ignition and the temperature and pressure of the explosive gas. Its easy ignition in contact with large incandescent surfaces leads to the supposition that the temperature of ignition falls, and that of the gas rises, but those authors do not consider that, practically, there is any appreciable connection between these variations. The statistics of the German Commission and its experiments with explosives are not more instructive. Nor has the French Commission on explosive substances determined what might be the influence of temperature of the atmosphere, where a mine shot is fired, upon its inflammability. But it was, in the opinion of the author, during the experiments at Schlebusch, at the manufactory of the Dynamite Actiengesellschaft, that this influence was clearly manifested.

It was at the time when experiments were made for arriving at the best composition for grisoutite. Various mixtures had been compared, with charges varying from 80 to 200 grammes, without tamping, or with coaldust tamping, and in mixtures impregnated with coaldust and containing 0 to 16 per cent. of gas The temperature had not exceeded 30 degs. Cent. (86 degs. Fahr.), and no ignition had taken place; but at the thirteenth experiment, with a temperature of 35 degs. Cent. (95 degs Fahr.) an explosion occurred. After a great deal of discussion, it was determined to attribute the cause to the temperature. Two more experiments were made at 30 degs., under the same conditions; but no explosion ensued. When, however, the temperature was again raised to 35 degs., explosion again occurred. There was no more room for doubt; to avoid a fresh ignition the gases of detonation must be cooled down. In principle it was possible to arrive at this result by charging a portion of volatilisible salt on the top of the explosive; and two experiments in this direction confirmed this supposition. The result might be still better attained by increasing the proportion of hydrated salt, incorporated in the explosive, for the same quantity of explosive substances. Thus,

three charges of 200 grammes (6⅔ oz.), tambed with coaldust and blown out into a dusty atmosphere containing 12 per cent of gas, gave rise to neither ignition nor explosion, although the temperature was raised to 35 degs.

It was thus proved that the proportion of dydrated salt for preventing ignition must inercase with the temperature of the explosive atmosphere, the harmlessness of which it was desired to ensure. What ean this be but that the "apparent temperature of ignition," as defined by M. Mallard and M. Le Chatelier increases with the temperature; it would, therefore, be a function of the pressure of explosion and of the surrounding temperature. It follows that the degrees of safety possessed by the various explosives can in reality only be relied upon, subjeet to the condition that they be made with an equal surrounding temperature; because—as may be deduced from the Schlebuseh experiments—the limit of temperature where safety ceases to exist, may be such as is met with in the undergroudd workings of a eollicry. With a variation of 1 or 2 degs. in temperature, any explosive normally harmless, may beeome dangerous, or, at any rate, lose its quality of safety. Deep and hot mines are therefore more dangerous than others; and in this case again the first remedy for the evil is powerful and abundant ventilation.

As the Schlebush result must leave doubt on the subject, the author quotes, from the report of the French Commission on Explosives, facts to prove that the explosive itself is highly sensitive to the influence of temperature. The above Commission also deals with the question in a special chapter as to the possible influence exerted on the inflammability of firedamp by the quantity of steam contained in the air, in the eourse of which the following observation occurs:—"It is possible that if the quantity of watery vapour contained in the atmosphere be increased, the inflammability of firedamp may not be so much reduced as it would otherwise be." The report then quotes Mr. Dixon's deductions, that carbonic oxide does not combine with oxygen, under the influence of the electric spark, when the gases are perfeetly dry, observing that a similar fact as regards gasy mixtures would be of great importance in collieries where the air is generally saturated with moisture. One more quotation from the report terminates in the following words:—"Laboratory experiments have not permitted of notieing any appreciable difference in the inflammability of mixtures containing more or less humidity."

Considering the importance attaehed by the author to the influence of temperature, he has recorded fractions of degrees, the thermometer used in the Produits experiments being graduated to tenths of a degree (Centigrade). Suspended about the middle of the gas chamber, it recorded the mean temperature of that ehamber; and a clay plug closed the aperture by which the thermometer was introduced, so as to avoid any escape of gas. The reason why the thermometer only marked a mean of the temperature was on account of the heating apparatus, which consisted of a steam coil of five spirals of equal diameter, held by flanges against the wall, behind the boiler. The temperature was therefore necessarily higher near the cannon's mouth; and the products of the explosion, representing a blown-out shot, thus passed through the most dangerous point of the atmosphere first of all.

In the top of that part of the boiler which constituted the gas chamber, three man-holes had been cut; and the covers which closed them rested simply on india-rubber rings; but chains, the links of which are made of ½ in. round iron, attach them to much stronger rings riveted to the boiler plates. The covers were well luted with clay every time that gas was introduced into the apparatus; and in this way the covers formed safety valves, while they also aeted, to a certain extent, as dynamo-meters, the intensity of the explosion being shown by the manner in which these covers were lifted up, and thrown forward or torn off. One explosion, with foreitè, threw one of the covers a distance of 40 m. over the wall of the enelosure; another, with Favier explosive, threw a cover to almost the same spot; and another, 45 m. distanee over a double span of coal-shed roofs, similar effeets being obtained with the same explosives in other experiments.

Spontaneous Combustion in Coal Mines. *

In submitting the following paper on "Spontaneous Combustion in Coal Mines," the author does so rather in the hope of elieiting valuable information in the discussing, than with any expeetation of conveying knowledge to those members whose experience has been gained in mines liable to this species of catastrophe. The few remarks submitted are the result of knowledge gleaned in his experience and travels in districts most liable to spontaneous eombustion, such as Leicestershire, Warwickshire, Staffordshire, and in other districts where it is less frequent, such as Yorkshire, Derbyshire, and Nottinghamshire. He is, however, also indebted to the various papers add writings of others, published in the proceedings of the various seientifie bodies, and to his private correspondence with mining engineers and chemists, whose assistance he gratefully aeknowledges.

Most of the dangers and diffieulties encountered in a mine, can be overcome in certain well-known ways; water can be raised by pumping-engines; gas can be carried away by ventilation, and the danger obviated by safety lamps; faults ean be passed through by sufficient expenditure of money; but spontaneous combustion can hardly be prevented, and when onee begun it is sometimes impossible to stop it, except by some proeess that involves the entire elosing of the colliery.

Spontaneous eombustion of coal or as it is sometimes, and perhaps more correetly called spontaneous ignition, means the firing of eoal without the direct applieation of a lighted match or other flame.

In some cases the cause of spontaneous ignition is obvious. Take for instance a ventilating furnace built in a seam of coal. The heat from the fire makes the brick-shale work hot, and raises the temperature of the coal or coal adjoining to the point necessary for ignition, which is between 700 and 800 degs. Fahr. The remedy for this kind of spontaneous ignition, if it can be so called, is very simple, and that is to separate the coal or coal shale from the furnaee by a passage eonveying a current of cool air. It is not enough to provide an air space, because air is as easily heated as any other substanee; it is necessary to provide a constant current so that there may be always cool air between the arch containing the furnace and the arch supporting the eoal or other strata.

But spontaneous ignition often takes place under conditons where there is no fire or any apparent source of heat equal to 700 or 800 degs. Fahr. Any large heap of ordinary bituminous coal is liable to spontaneous combustion—say, one, 10 feet thiek and 30 or 40 feet square. The larger the heap and the smaller the coal, the greater the liability of fire. Thus, a heap of coal built up of large blocks of hard coal 15 feet high will probably not take fire, but a heap of slack of equal height from the same seam would probably take fire.

If a little artificial heat is applied to a very small heap of slaek, of say, 2 or 3 tons, it is liable to fire. Suppose, for instance, there is a brick flue carrying the hot gases from a fire to a chimney and 3 or 4 tons of slack are tipped against this flue, it is very likely to take fire. The reason of this again is very obvious. The outside of the boiler-flue feels cool, because it is exposed to the wind, but the inside of the boiler-flue is very hot, perhaps 800 degs. Fahr., or more in temperature. When the slack covers the external wall the heat is no longer carried away, and the outside of the brickwork in a few days will become nearly as hot as the interior, whose heat is quite sufficient to set fire to coal.

There are, however, other cases less easily understood. For instance, if a heap of coal be laid over a steam pipe it will soon take fire, though the temperature of the steam and the pipe never exceeds 330 degs. Fahr., which is less than half the temperature required for the ignition of coal. But this is not so eurious as the iginition of coal where there is no artificial heat of any kind.

Coal is not the only substance that will inflame without the application of a match. If newly burnt eharcoal is ground up, it will take fire. Rags or waste soaked with vegetable oil and put in a heap will take fire. Very finely divided iron or lead will also burn. Phosphorus takes fire with the warmth of the hand. The eompression of air, by means of a piston in a syringe, will give heat suffieient to ignite ether or tinder soaked in a solution of nitre.

In coal mines there is a general liability to spontaneous combustion in the majority of the coal fields of Great Britain in some distriets it is exceedingly rare, and in others it is exceedingly common. Experience shows that it is very rare in thin seams and very eommon in thick seams; and that in seams of equal thickness it is more likely to occur where a large proportion of the seam is left in the mine, either as slack or as roof coal. In fact, spontaneous combustion, as a general rule, occurs in those mines where a great deal of small and broken eoal is left in the goaf, and is hardly, if at all, known in those mines where all the eoal is sent out, and where there is no eoal in the mine except the solid uncut seam or large and uncrushed pillars.

The distriets where gobfires are most common in Great Britain are South Staffordshire, West Leieestershire, and Warwickshire.

In South Staffordshire, the Ten-yard coal is worked pillar and stall. It is got in panels, locally termed "sides," say about 80 to 100 yards square, in which area there would be sixteen or twenty pillars about 10 yards square. The whole of the eoal between the pillars and the ribs separating the sides or panels is got, with the exception of the roof coal, say a yard in thickness, which is left because of the danger of trying to get it. A good deal of slack and of coal mixed with dirt is also left in as being valueless. In eourse of time the roof falls and a good deal of coal no doubt breaks off the sides of the pillars. Thus considerable heaps of eoal, dirt, and slack are formed, and in a short time these heaps frequently get very hot, and unless precautions are taken they would burst into flames.

The usual method of preventing this is to put stoppings in all the roads leading into the "side" so as to prevent any fresh air having access; thus any combustion that begins speedily exhausts the oxygen, and further combustion is so prevented. The slow combustion, however, so far as it takes place, has the effect of making the mine in that part exceedingly hot. In some places air draws through cracks in the ribs, so that a more rapid eombustion can take place and great heat is produced. The main roads leading past these hot districts, are sometimes arched with brickwork, to assist in the exclusion of the air and to maintain a good road. Sometimes the brickwork gets so hot that it cannot be touched. As a general rule, however, the exclusion of the air stops the combustion. After the whole of the mine has been worked the sides are often re-opened to get the pillars and ribs.

In Leicestershire the coal is worked in two ways; sometimes by long-wall and packed gates, and sometimes by heading out and working back. Where the paeked gates are used, the packs are made impervious to air by means of wax walls. These wax walls are made of clay, which has been worked to the proper consistency for making bricks, and is sent down in large lumps about 9 inches square and 18 inches long, and is built up into walls on each side of the gate road, while small dirt is packed on each side of the wax walls. These walls being soft have no strength to support the roof, and the packs are made to a great extent of wood. The wood used is the small branches of trees cut into lengths of about a yard and built into square piles: It is commonly called "brattice wood." These timber packs are placed about 4 feet apart, and the space between them is filled up with stone made for the ripping of the gate roads. In this way the goaf between the gate roads is kept from the air current; the only place where the air comes in contact with the goaf is close to the working face. In order to prevent the air from getting back into the goaf near the working face, the ventilation is kept as slack as is consistent with safety. The face is moved forward pretty fast, say, 2 or 3 yards a week, and consequently the goaf near the face has not time to heat. If, however, there should be a stoppage, owing to slackness of trade or a strike, the goaf would take fire at the face; and to prevent that, the wax wall has to be carried along the face from gate road to gate road.

Mr. Alfred Ely, in a valuable paper read before the Chesterfield and Derbyshire Institute, in April, 1877, describes another method of excluding the air from the goaf at the face. He paeks a bank of dirt all the way along the face on a slope from the roof to the floor. The face of this slope he then covers with a layer of sand 6 inches thick, which has the same effect as a clay wall in keeping out air.

Where the system of heading out and working back is employed; no wax walls are required, exeept during a stoppage, and then a wax wall is run along the face between the coal and the goaf, so as to exclude the air from the goaf.

In some collieries, the manager arranges as far as possible to finish off a district before the summer when trade is slack, and then he opens out a new district ready for the ensuing winter; the point to be aimed at being that the air eurrent must never pass over or through heaps of slack or broken coal as in a goaf.

In Warwiekshire the liability to spontaneous combustion is met by working the face as quickly as possible. For this purpose a number of coal-getters are eoneentrated in a small area. Where ever practicable, the mine is worked by heading out in the solid, and then bringing the coal back.

In many Warwickshire mines, the bulk of the coal lies to the dip of the shaft; in this case the headings are driven down to the dip boundary, and then the coal is brought back, the goaf being allowed to fill with water.

Both in Warwickshire and Leicestershire, a considerable portion of the coal in the seam worked is not got, being of slightly inferior quality to the coal that is got. Also a good deal of slack is left in the mine, so that there are great heaps of slack and broken coal.

But the question now arises, how can this coal take fire considering that the natural temperature of the earth in these mines is, say, from 60 degs. to 65 degs. Fhr.?

The explanation formerly given was that the iron pyrites, that is, disulphide of iron (fe S), which is often found in the coal and in the shales, is decomposed by the oxygen of the air, and that this decomposition is aecompanied with heat. It has been found by experiment that in some cases great heaps of shale, containing a large percentage of iron pyrites, have taken fire through the decomposition of the pyrites. But the amount of pyrites in the coal mines is too slight to have any appreciable effeet in heating the coal, and this theory is now given up by those who have most studied the question.

Prof. Vivian B. Lewes, has made some valuable contributions to the knowledge of this subject in papers read to the British Association, in 1891, and subsequently to the Society of Arts. He states that it has been demonstrated by Richters, that newly cut coal will absorb oxygen; some coal absorbing 1¼ times its own bulk, and other eoal 3 time its own bulk.

How the oxygen gets in and is compressed into the very small space it must occupy is another question, but there is no doubt that it does go in, and that active chemical decomposition of the coal takes plaee, forming carbonic acid gas and water, and that this decomposition is aecompanied with considerable heat.

The hotter the mine the more rapid the decomposition, so that the process of heating when once begun goes on at an accelerating ratio, or in geometrial progression provided there is a suffieiency of oxygen to keep up the the combustion.

In mines where the air is sueeessfully kept from the goaf however, the heat rises up to a eertain point sufficient to make the mine very warm, but does not exceed that point, and then cools down again, because there is not enough air for further slow combustion.

The return air of a mine, the natural temperature of which is about 62 or 63 degrees Fahr., will probably be 70 degrees, and in some places warmer still.

In order that the heat may get up to the point of combustion, it is necessary that the coal or slack should have no opportunity of cooling. In the case of a very large heap of slack the heat which is generated in the centre cannot escape, and in the case of a small heap of slack, which is buried in the goaf of a mine, the heat there also is kept in by the cover of shale and roof. But while the

* Paper by A. Lupton, Transactions Federated Institution of Mining Engineers.

cover keeps in the heat it also excludes the oxygen, which is necessary for combustion; therefore, the heating will arise from the oxygen which is taken into the coal before it is finally covered up by other coal or by falls of roof, and the heating proceeds from the centre of the heap outwards. But if, when the heat from the centre has reached the outside of the heap, there is a supply of fresh oxygen at the outside, the heap will rapidly take fire.

Where the workings in a long wall face are being moved rapidly forward, the outside of the heap never gets hot enough to fire, because the heap is being continually lengthened and the old part of the heap is kept from the air by the wax walls on each side and the new stuff in front.

It is sometimes recommended, as a way of preventing spontaneous combustion, that the goaf should be cooled by strong ventilation.

There is no doubt that this cooling by ventilation will prevent a gob fire, if it is thoroughly efficient. That it may be efficient it is necessary that there should be no large heaps of broken coal, because the wind cannot be forced through these heaps, and, as a general rule, it is found impossible to prevent combustion by cooling, so it has to be prevented by the exclusion of the air. The air roads would have to be within a few, say 15, feet of each other to ensure effective cooling.

When every precaution has been taken it will happen, however, that the mine will catch fire in places, and unless these fires are immediately extinguished, the flames may rapidly extend to the whole mine. It is therefore necessary that the mine should be continually traversed and examined for any signs of combustion, which is usually detected by the condensation of moisture or the pungent odor from the heating mass.

In many cases, as soon as heating is discovered it is put out by simply digging out the hot part and sending it out of the pit, and in some cases, filling up the place with sand. It sometimes happens, however, that the mass of hot material is too large to be dug out, and a sort of hand fire engine has been used to pump water on to the fire, after which the combustible material is dug out and the place filled with sand.

In some mines water is laid on all over the mine under pressure, and is ready for extinguishing a fire from whatever cause it may arise.

In a great many cases the only way of extinguishing a fire is to build off the district in which it occurs. In this case, the stoppings are generally made by building a brick wall with mortar, this wall is sometimes faced with a clay wall, which is kept damp and constantly smeared to close all the openings and so prevent air from drying it. Several stoppings are built a few yards apart, so as to reduce the chance of leakage past the walls. The burning coal in the enclosed area soon exhausts the oxygen, and then the fire goes out.

If, however, there should be any tendency due to the ventilating pressure of the mine for air to pass through this district, it is exceedingly likely that some air may find its way in and keep the fire smouldering, ready to relight as soon as the stoppings are pulled down. Sometimes such a fire may smoulder for thirty years, and there are cases of underground fires that have lasted a longer period.

The only certain way of extinguishing a large fire is to submerge the mine or district of the mine under water; this is never resorted to until every other plan has failed.

Cases have happened where gob fires have not been even subdued by the stoppings built, but owing to air drawing through cracks in the coal pillars, the fire has gone through the pillars.

In one mine known to the writer he has been told that the pillars of solid coal fired spontaneously not far from the upcast shaft, and before the fire was discovered it had reached proportions which made it hopeless to extinguish it. It was therefore necessary to close the pit, and the shafts were stopped by hanging scaffolds about 20 yards down by means of chains, and on to these scaffolds was put earth and clay, filling up the shaft completely to the top. The air being thus entirely excluded, the fire extinguished itself by burning up the oxygen, and subsequently the mine was re-opened.

Sometimes, the exclusion of the air from a district in a mine which has taken fire involves the building of a great length of brick wall, owing to the joints in the roof and coal permitting the air to pass; but by building all round the district a brick wall, which is dug into a trench in the floor and into a nick in the roof, the air is excluded to a sufficient extent to permit of the working of the colliery.

Where a main road has to be taken through a district which is hot it is often best to arch it with brick-work, the arch being surrounded with sand. In order to prevent the air drawing through cracks in the floor, the archway is inverted, the invert also being laid on sand. The object of the sand is to cover up all small holes in the brickwork, or any cracks that may subsequently occur therein, and so prevent air drawing through. It must, therefore, be very carefully rammed into position. The inside of the wall may be lime-washed from time to time, to fill up the cracks in the wall.

If a fire in a mine once gets fairly hold of the coal in a place where there is a sufficient supply of air, the heat produces a great deal of gas from the coal which may form an explosive mixture with the air, and thus a serious explosion may result.

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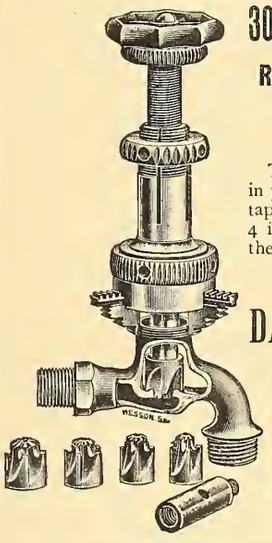

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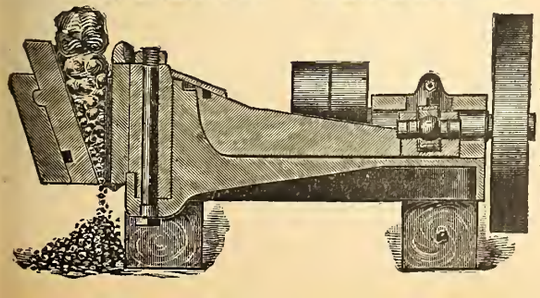

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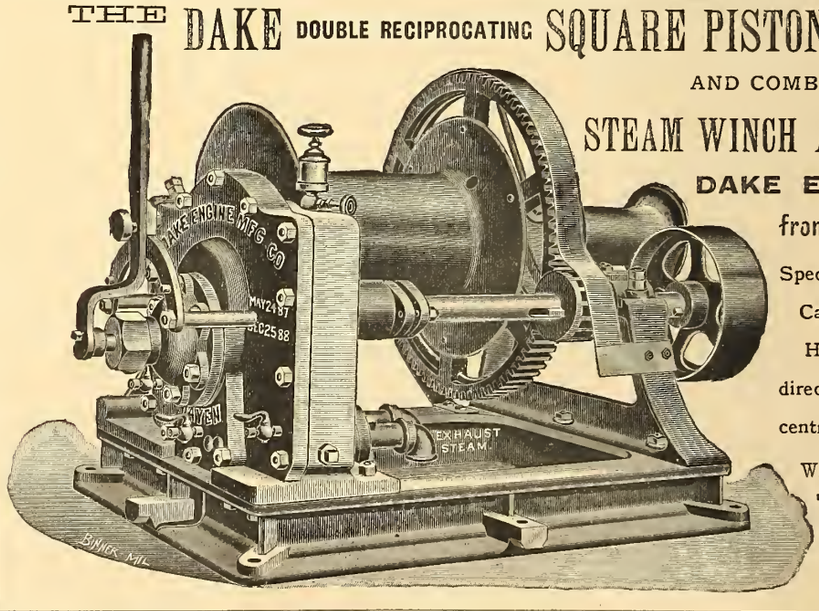

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The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

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SOME REMARKABLE RESULTS IN GOLD EXTRACTING.

New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mereury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan I.. &. Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

W. D. Sutherland, Secretary of the Salisbury Gold Mining Co., of Nova Scotia, after having over 4 tons of ore treated by the Crawford mill, says: "Sample of the tailings taken during the run showed by assay an equivalent to 0.033 oz. to the ton. This evidence of the capability of the Crawford mill to extract all but a trace of the gold which the ore may contain must be considered of importance by all who are interested in the question of improved methods of milling gold from the ore. The test alluded to was made under the supervision of our company through trustworthy agents."

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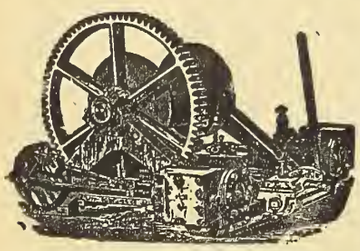

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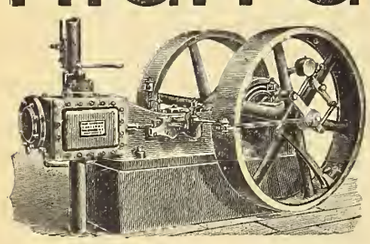

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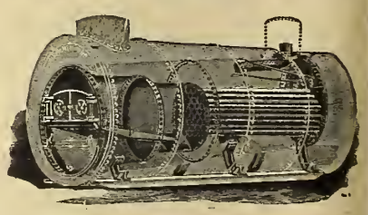

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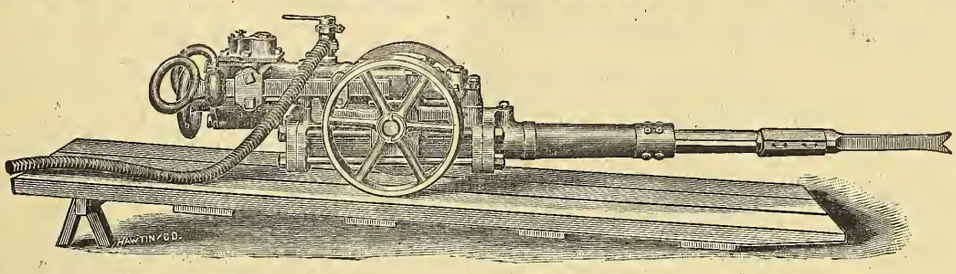

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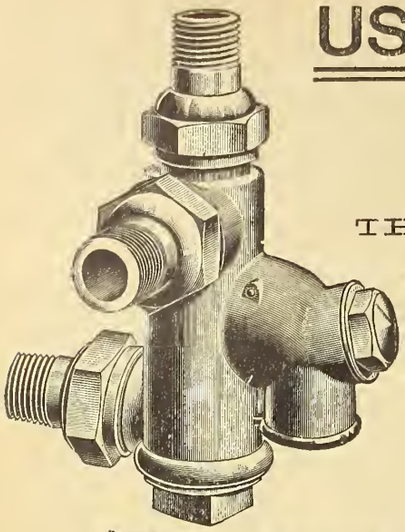

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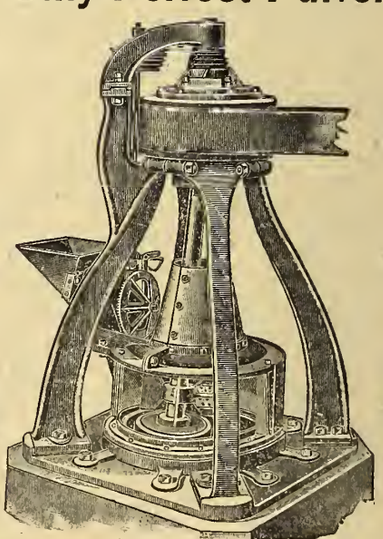

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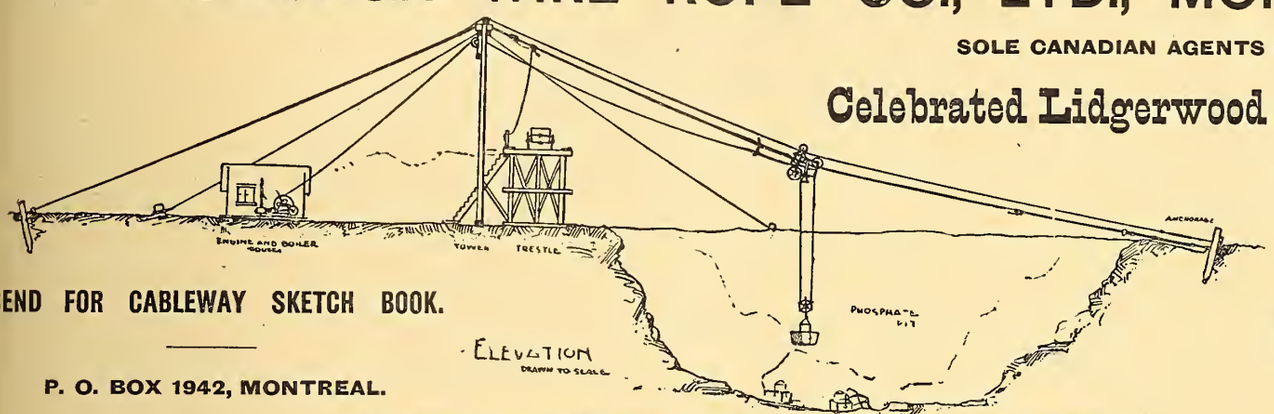

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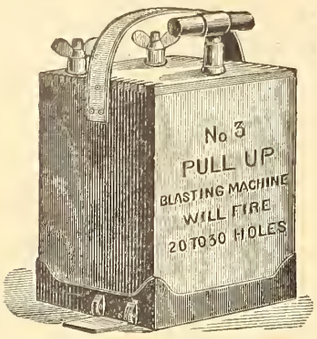

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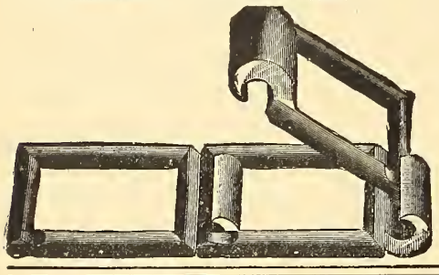

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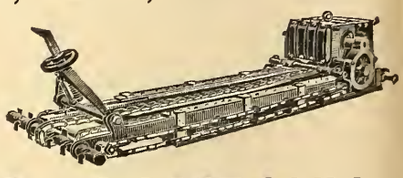

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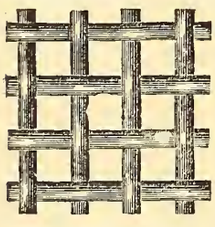

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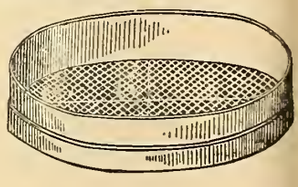

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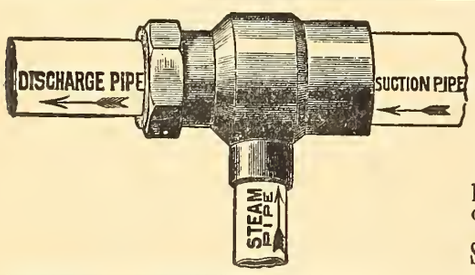

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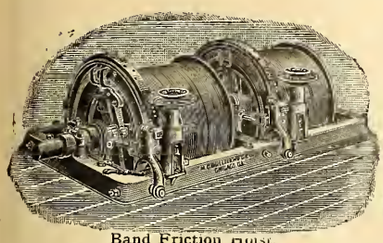

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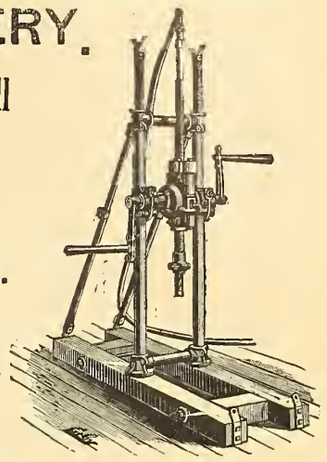

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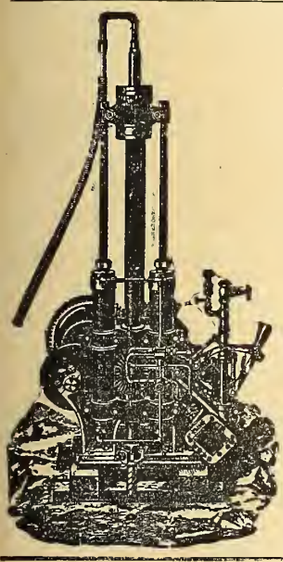

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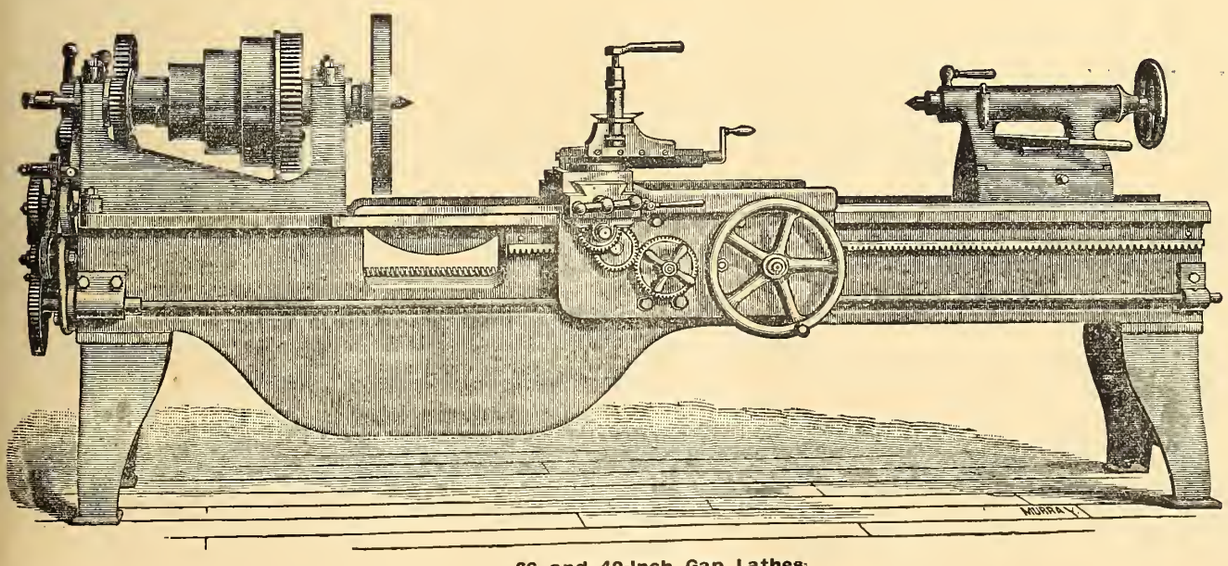

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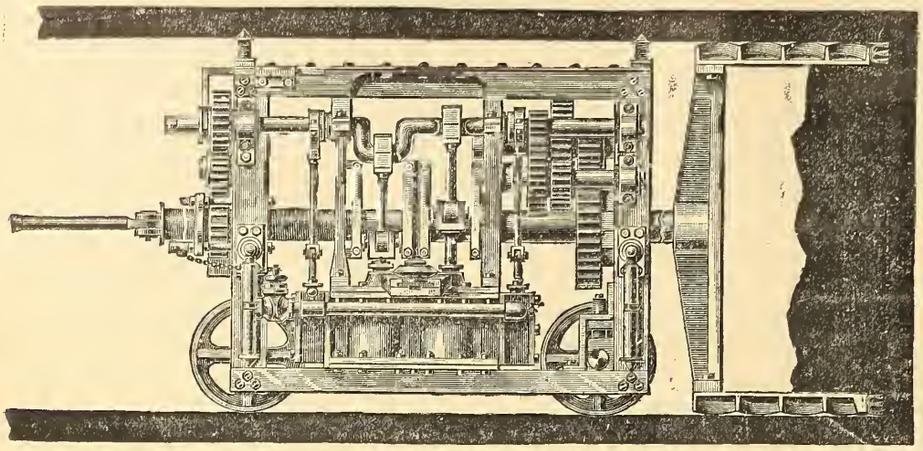

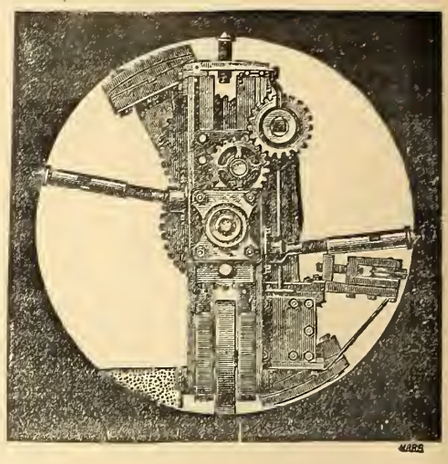

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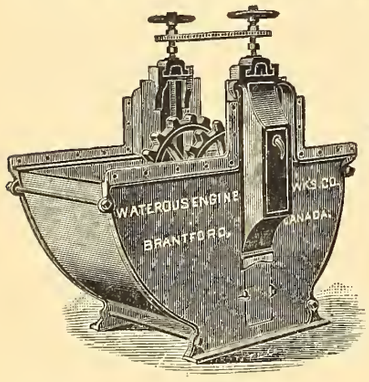

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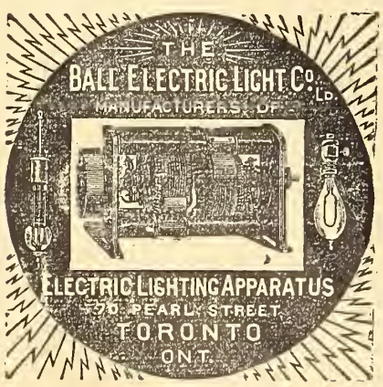

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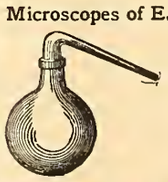

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TORONTO, April 24, 1892.

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Synopsis of "The General Mining Act," Chapter 16, 54th Victoria.

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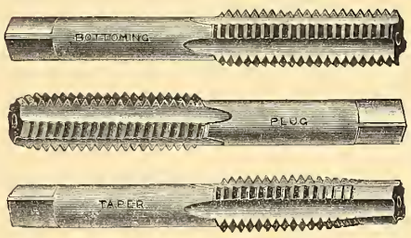

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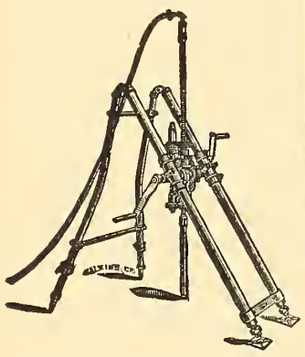

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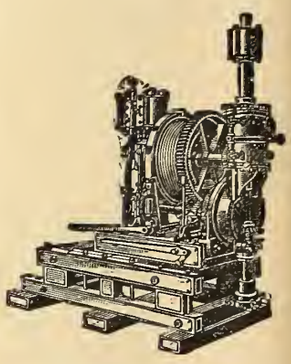

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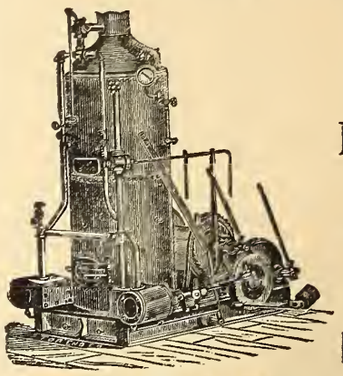

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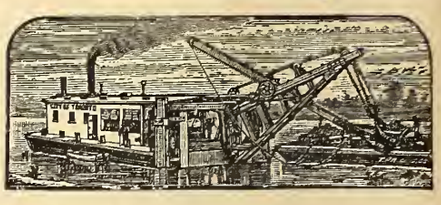

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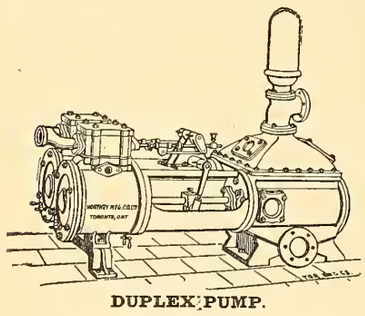

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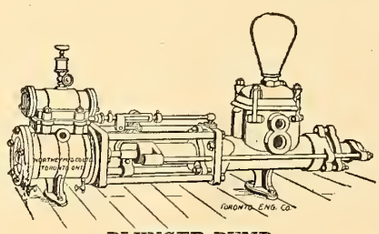

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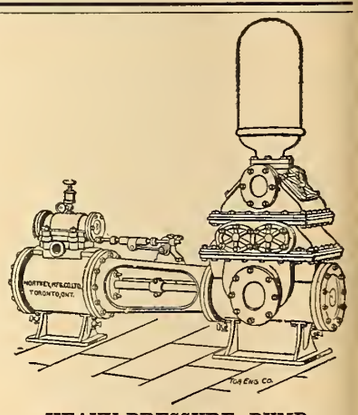

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Excursion of the General Mining Association of the Province of Quebec. Photo of Group taken at the Owl's Head, Lake Memphremagog, Que.

SUMMER MEETING

OF THE

General Mining Association

OF THE

Province of Quebec at Sherbrooke.

The summer meeting of the General Mining Association of the Province of Quebec, was held in the Art Hall, Sherbrooke, on Wednesday, 5th July. There were present: R. T. Hopper, (Anglo-Canadian Asbestos Co.), Montreal; F. P. Buck, Dominion Lime and Marble Co.), Sherbrooke; Col. Lucke and J. S. Mitchell, (Beaver Asbestos Co.), Sherbrooke; John J. Penhale, (United Asbestos Co.), Black Lake; L. A. Klein, (American Asbestos Co.), Black Lake; Capt. John J. Williams, (New Rockland Slate Co.), New Rockland; S. L. Spafford and A. W. Elkins, (Nichols Chemical Co.), Capelton; John Blue, (Eustis Mining Co.), Capelton; F. C. Thompson, Sherbrooke; John McCaw, Sherbrooke; George R. Smith, (Bell's Asbestos Co.), Thetford Mines, Que.; John W. Jenckes, Sherbrooke; and B. T. A. Bell, Ottawa. In the absence of the Hon. George Irvine, Q.C., president, Mr. R. T. Hopper was called to the chair.

Election of New Members.

The Secretary read the names of the following gentlemen who had been elected to membership since last meeting:—

Frank Gilbert, Gilbert Engineering Co., Montreal, Que.

James S. Mitchell, Beaver Asbestos Co., Sherbrooke, Que.

S. L. Spafford, Nichols Chemical Co., Capelton, Que.

A. W. Elkins, Nichols Chemical Co., Capelton, Que.

J. N. Greenshields, Q.C., Danville Slate Quarry, Montreal, Que.

Wm. King, King Bros., Thetford Mines, Que.

D. L. Lockerby, Montreal.

J. R. Woodward, Sherbrooke, Que.

Fernando Wadsworth, American Gold Co., Gilbert River Gold Mines, Que.

C. N. Martin, Eustis Mines, Capelton, Que.

F. C. Thompson, Sherbrooke, Que.

Frank Gundry, Sherbrooke, Que.

Capt. W. Prideaux, Black Lake, Que.

John McCaw, Sherbrooke, Que.

Invitation from the Mining Society of Nova Scotia.

The Secretary read the following telegram:—

"HALIFAX, 5th July, 1893.

"Mining Society of Nova Scotia will hold September meeting in Halifax, and extends to General Mining Association of Quebec cordial invitation to participate."

[Signed] H. M. WYLDE, *Secretary.*

He would move that the September Quarterly Meeting of the Association be not held, and that the invitation of the Mining Society be accepted.

MR. F. P. BUCK—What is the date in September?

MR. BELL—The date is left open.

MR. BUCK—Accept the invitation and get as many as we can to attend.

MR. JOHN BLUE—I second the motion.

MR. G. R. SMITH thought that the Association might easily arrange to run a car from Montreal.

The Date of Meetings.

MR. F. P. BUCK—We should meet twice a year instead of four times. If this were done, greater interest would be taken in the proceedings, and the attendance would be increased.

MR. BELL—In order to effect such a change, notice would have to be given to amend the Constitution.

MR. KLEIN—Three-fourths of the members present can decide the point.

MR. BELL—No; notice of motion must be given.

MR. JOHN BLUE—I think we ought to have three meetings; one in the Ottawa district, one in the Townships, and one in Montreal.

MR. WOODWARD agreed with Mr. Blue that three meetings only were desirable.

MR. BUCK having expressed himself as agreeable, Mr. Blue gave notice of motion to amend the Constitution in this particular.

The Duty on Mining Machinery.

THE SECRETARY read the statement of the various classes and kinds of mining machinery manufactured in Canada which had been prepared by sub-committee at a meeting held in Sherbrooke on 12th May. This had been forwarded to the Mining Society of Nova Scotia, who had added to it, and had returned it duly confirmed. The sub-committee recommended that the Association ask the Government to have the language of the Act changed to read: "That all machinery and appliances for mining, quarrying, smelting, concentrating, refining and treating ores or minerals of a class or kind not manufactured in Canada, be admitted free of duty." They would remember that the Act as at present worded restricted the free entry to machinery for mining purposes only. The committee was also of opinion that steel rails exceeding 25 lbs. in weight for use in mines and quarries should be admitted free of duty. At the meeting of the Mining Society of Nova Scotia, Mr. J. F. Stairs, M.P., had stated that all rails over 25 lbs. were admitted free of duty.

MR. MITCHELL—That is rails for railway purposes only; not tramways.

MR. BELL—I understood the Act read for railways and tramways.

MR. WOODWARD moved that the report of the sub-committee which met in Sherbrooke on 12th May be adopted, and that a copy of the resolution containing the clause relating to steel rails, be forwarded to the Minister of Customs.

MR. BLUE—I second Mr. Woodward's motion. The motion was carried.

The Powder Magazine Law.

THE CHAIRMAN—Some time ago, when the Association was discussing the powder license question, the point was incidentally introduced that as the law stood at present no mining magazine in the province was constructed according to the Act, and that any accident would probably render the owners responsible for damages in the event of loss of property or lives, as well as render them liable at any time to the payment of a fine for not complying with the requirements of the Act. At the time, this suggestion received scant consideration, as it was generally considered by those present that the Act was not intended to cover the storage of mining explosives, but, rather was meant to regulate the storage and sale of explosives in the neighbourhood of large cities. Some time ago one of our workmen was slightly injured by an explosion of our powder house during a thunderstorm, and he brought an action to recover damages. A judgment was given in our favor in the court of first instance, on the ground that the non-compliance with the Act above referred to, subjected the company to a fine for such non-compliance, but did not render us liable to damages for injuries resulting therefrom. In the Court of Review, however, judgment has recently been given reversing that of the court below, on the ground that notwithstanding the fact that the accident was caused by lightning, and, therefore, beyond our control, still that the company was responsible for the damage because they had not erected a powder magazine in accordance with the terms of the Act.

MR. MITCHELL—If lightning struck a building built according to this law at your place, what would have been the result?

MR. HOPPER—Great destruction of life and property would have been inevitable.

MR. KLEIN—I saw the report of Provincial Revenue Inspector Poston, when he was around inspecting the powder houses. He recommended that the present style of powder house, built of boards and shingles, as the only proper style. The Government has evidently accepted this opinion of Mr. Poston and have issued licenses for 1891 on this report.

MR. HOPPER—The law has not been changed.

MR. WOODWARD — Then the law should be amended according to Inspector Poston's recommendation.

MR. JOHN PENHALE—The man suing for damages in this case had no business on the property at all, and yet Mr. Hopper's company was held for damages. Might not such a thing occur to any one of us, even if the inspector accepted our license cheque, and passed, in his report, the construction of our magazine?

MR. BUCK moved, seconded by Mr. G. R. Smith, that Messrs. R. T. Hopper, J. S. Mitchell and John Blue, be named a committee to watch legislation respecting powder magazines and licenses. The motion was carried.

After some discussion about the publication of the Proceedings of the Association, which the Secretary promised would be ready for distribution before the next meeting, the Chairman called upon Mr. John Blue, Capelton, to read his paper on

The Eustis Mine.

MR. JOHN BLUE — The copper deposits of the Capelton District occur in the Pre-Cambrian formation, which comes to the surface over a large extent of country. The formation also contains beds of dolomite limestone, bands of dioritic rock and soft clay slates, and the whole is crossed with trap dykes which do not cause any displacement of the strata.

The ore deposits in the district are all found running in a north-east by south-west direction, with the stratification, which is composed of crystaline schists, generally of a talcose or micaceous nature.

In the records of the Geological Survey of Canada for 1863, Sir William Logan gives as his opinion that "the origin of the copper veins are contemporaneous with the rock formation, having been reduced to the state of sulphurets, and precipitated at that time with the sediment." At the time this opinion was advanced, comparatively little mining work had been done; but now that the formation has been exposed by some 25 or 30 years work, the generally adopted theory of the origin of the veins is attributed to segregation.

But whether formed by precipitation or segregation, the veins are undoubtedly irregularly stratified deposits, following the bedding, and interposed between the associated rocks.

In the district there are a large number of different and distinct veins running parallel with each other, and at the present time work is being done in four of them. On a number of the others more or less work has been done, but only on or near the surface, so as yet they can only be considered as but very imperfectly explored.

The vein on which is located the Eustis mine of the Eustis Mining Co., and also the Albert mine, operated by the Nichols Chemical Co., has been worked for some 30 years off and on, and continuously for the last 15 years. It is, so far as known now, the strongest and most persistent deposit in the district, extending laterally for over two miles, and in depth on the slope of the vein in the Eustis mine, to over 2,000 feet at this time, and at the lowest point the ore body is as strong and solid as ever, and has every appearance of continuing so for an indefinite depth.

The foregoing remarks being given as the general characteristics of the Capelton and surrounding mineral district, the notes to follow will refer specially to the subject of this paper, "The Eustis Mine."

The Eustis Mining Co., originally the Orford Nickel and Copper Co., and later on the Orford Copper and Sulphur Co., commenced operations in 1879, on lot 2, Range, 9, Township of Ascot, nine miles south of the city of Sherbrooke, Quebec Province, leasing the shaft known as No. 5 Hartford, which was sunk to a depth of 500 feet, in the property then owned by the Canadian Copper and Sulphur Co., and now by the Nichols Chemical Co. of New York.

At that time the only means of reaching the ore bodies in the Eustis Mining Co's lands was through this No. 5 shaft, for the reason that the vein crops out on the surface about 200 feet north of their line, and crosses it at 500 feet from the surface, measuring along the slope of the vein.

Under these circumstances—being at the mercy of a foreign corporation, who might at any time refuse to renew a lease of their shaft, and so stop all operations, and for other important reasons—it was decided to take steps to confine all operations within the company's own boundaries, and to do so it was necessary either to sink a vertical shaft to strike the vein, or reach it by a cross-cut into the mountain. After mature deliberation, a cross-cut or tunnel, as it is called, was agreed upon as the best method, and subsequent operations have confirmed the soundness of this decision.

This tunnel is nearly 1,000 feet in length, about seven feet high, by seven feet wide, and has a descending grade from the inside of six inches per 100 feet—enough to carry off the water from the upper workings.

The vein, as already mentioned, is an interstratified bed, running in a north-east and south-west direction. The dip is to the south-east and is very irregular, in places being almost perpendicular, and in others nearly horizontal. The average slope is between 35 and 40 degrees from the horizontal. The irregularity of the dip may be accounted for at the period of disturbance by unequal pressure at different points, thus producing a partial folding of the stratification.

The hanging walls generally are smooth and regular, conforming to the bedding of the associated rocks; but in the footwall numerous depressions or crevices filled with ore occur. These are found in many different forms, sometimes having the appearance of branch veins running up and down the slope, others apparently branches running laterally across the vein, and again some are basin-shaped hollows or "squats" occasionally 20 to 30 feet deep, but all of them coming to an abrupt termination, and all showing the extreme irregularity of the bed on which the vein matter was first deposited.

Horses of country rock and boulders of greenstone are of frequent occurrence in the vein.

Four trap dykes running almost parallel with each other in a N.E. by S.W. direction, cut vertically through the vein, but do not disturb or affect it in any way, a proof that they have had their origin subsequent to the formation of the vein, and in all likelihood since the stratification was tilted up into its present position.

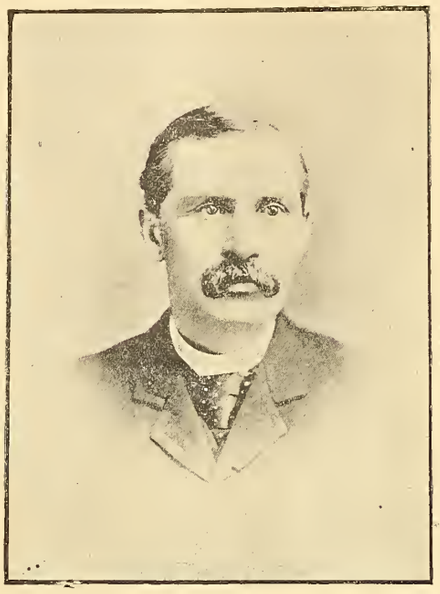
Slides or displacements of the vein are met with in three places, one of them being an up-throw of 25 feet, the others causing displacement of only one or two feet. These do not change in any way the general characteristics of the vein or vein matter, and are also disturbances which have taken place since the stratification assumed its present position.

The ore occurs in large bodies or lenticular masses, narrowing down laterally to small dimensions. The vein is continuous between these masses, but is too small to work and is besides usually low grade in quality.

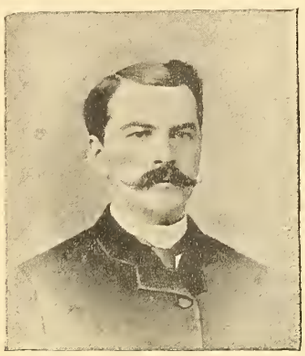
The deposit being worked has a length of about 350 feet, and varies in width from 3 feet at the extreme ends to over 60 feet at the widest part of the chamber.

The ore is copper pyrites, and varies in copper contents from 2 to 30 per cent. The sulphur varies also according to the amount of copper and silica in the ore, some samp-

S. S. Spafford, Capelton, Manager
Nichols Chemical Co.



Mr. John Blue, Capelton, Que.
Manager Eustis Mines.



Mr. J. S. Mitchell, Sherbrooke,
(Beaver Asbestos Co.)

les showing 48 per cent. and others only about 30 per cent. An analysis of an average sample of the whole deposit would show about 42 per cent. of sulphur, 4 per cent. of copper, also 3 ozs. of silver, and about 40 cents worth of gold per ton of 2000 lbs.

The ore is bi-sulphide, burns very freely, and is admirably adapted for making sulphuric acid.

The method of mining now in use was adopted to suit the peculiarities of the deposit, and differs from the ordinary plan of sinking shafts, driving drifts, sinking winzes, etc., in that two shafts are sunk in the ore body on the slope of the vein, about 175 feet apart, each of them carrying down from 40 to 50 feet in length of the vein, and the full width from foot to hanging wall: the shaft work in this way being practically underhand stopeing. The

Mr. F. P. Buck, (Chairman Local Committee), General Mining Associatien of Quebec.

shafts diverge from the same landing till the necessary distance between them is obtained; from this point a curve in one shaft allows of their running parallel to each other.

The reserves of ground opened up by this system of sinking consist of the body of ore between the two shafts about 125 feet in thickness or length, and the two bodies outside of the shafts, each from 50 to 75 feet in length.

The advantage claimed for this system of working is economy—first in sinking shafts, always an expensive part of mining work, but in this case costing it may be said absolutely nothing, as the ore can be obtained from the shaft work at as little cost as from any stope in the mine of the same character. Again, drifts are dispensed with except in special cases, such as connecting the shafts for ventilation, for exploratory purposes, or for some peculiarity of the formation, and winzes or rises are unknown except in the case of working around pillars.

The reserve ground is worked out by breast and underhand stopes; back stopeing being resorted to and only possible from the exploratory or ventilating drifts.

The skip tracks are protected from the blasting operations by heavy timbers, lagged to the hanging wall and put in alongside the tracks and running parallel with them. These timbers are necessary in any case, as the hanging rock is of a slatey, seamy nature, liable to wind and break off when exposed to the action of air and moisture.

One of the objections to working out the deposits by the usual method of drifts and winzes, is the closeness to each other that it would be necessary to have these drifts or levels; this being caused by the irregularities in the footwall, and the numerous steps or flat places on which the broken ore would lodge, making it necessary in many cases to handle the ore several times before it finally reached the levels.

With the system in use each or any of these steps may be utilized as a level, along which the ore is conveyed to the plats or bins at the hoisting tracks. About the only serious objectionable feature in the method of working is the difficulty in keeping the skip tracks in place in the bottom of the shafts, these being frequently broken or displaced by the blasting operations, although protected by heavy timbers. But this difficulty is more than counterbalanced by the many advantages of the method, of which the easy handling of the ore after it is broken, is one—this being practically loaded from the blasts into the cars.

The roof of the mine is supported by pillars of ore left standing in suitable places, and also by timbers, but the grouud is usually firm and solid and easily held in place, except in places where the strata is cut through by slides or dykes, and at these points heavy ground is always met with. In all other places protection is needed only from the bands of slatey rock that are partially loosened by blasting and exposure to air and water.

The mining work is all done on the contract system—all contracts being renewed at the beginning of each month. By this system, the miners having to pay for all the supplies they use, economy is ensured, and at the same time a fair day's work has to be done every day or the miners feel the effects of it at the edn of the month.

The average wage made by miners is from $40 to $50 per month, and occasionally $60 is made—the difference being due to the greater or less skill and ability of the men in their way of working.

Labourers are paid at the rate of $1.25 per day of eight hours—three shifts being worked in the 24 hours.

There are about 200 hands in all employed in and out of the mine. Of these about 20 are boys employed in ore dressing.

The mine is remarkably free from water; five or six hours pumping per week keeping it dry. The pump used is a Deane, with 6in. cylinder and 10 in. stroke. The suction is 3in.; discharge, 2in.; vertical lift, about 175 feet.

Nearly all of the water comes from the surface and upper stopes, and the greater part of it is caught and carried out of the tunnel without pumping. The bottom of the mine is so dry that miners occasionally have to carry down water for drilling purposes.

The water is so strongly charged with acids and copper in solution, and is so destructive to iron, that it is necessary to have the water end of the pump, piston, piston rods, etc., made of brass.

The water, when it leaves the tunnel, is caught in troughs and run over scrap iron, on which the copper in solution is precipitated. About two tons of cement, carrying 50 to 60 per cent. of copper is collected in this way yearly.

Two air compressors, one a straight line Ingersoll, 20in. x 30in. cylinder, the other a Rand compound 14in. x 22in. cylinder with condenser, and each of 10 to 12 drill capacity, furnish the compressed air for drilling. Rand and Ingersoll-Sergeant power drills are used, and eight of them are kept running night and day.

Hand drilling is resorted to only in very small veins or inaccessible places.

The compressors with two boilers 18 ft. by 6 ft. diameter to run them are set up outside the mine, and the air carried from them through the tunnel and down the mine in 4½ and 4 inch pipes to a point where it is diverted in smaller pipes to the different workings.

The mine is ventilated by diverting the air which goes in through the tunnel, and confining it by a tight brattice or dividing along the west side of the mine till it reaches the working stopes. It is there scattered through the workings and naturally finds an exit on the top of the mountain through Nos. 5 and 7 shafts. The exhaust from the drills also contributes to the ventilation of the mine.

The hoisting machinery is all set up in the mine at the inside end of the tunnel, and consists of two engines with 14in. x 26in. cylinders, coupled on to opposite ends of the main shaft. Three drums 6ft. 6in. in diameter are geared to this shaft, two of them being in use, and the third kept as spare in case of breakage. Two boilers 4ft. x 16ft. furnish the steam to run the winding engines. The smoke from the boilers and the exhaust steam is carried up to the surface through the old workings of No. 5 shaft, partly in an iron smoke stack 26ins. diameter, and partly in two columns of vitrified clay pipe, each 18ins. diameter. The total length of this chimney is 520 feet.

The rope used on the winding drums is made of the best crucible cast steel. It is 1in. diameter, has six strands with 7 wires in each strand, and hemp centre. The breaking strain is 25 tons; load about 4½ tons.

The skips or ore cars in use are made of steel, 5ft. long, 3ft. wide and 2½ feet deep, and hold about two tons. These cars are taken directly from the landing by horses, and hauled to the dressing shed, a distance of about 2,000 feet. The ore is dumped out of the cars on to a series of screens, which size it into roughs, pickings and fines. The rough ore and pickings are dressed by hand, the latter being first washed. The fines, which includes all that goes over a ¾in. screen, is taken to the jigging plant, and is first put through a revolving screen, dividing it up into coarse pea from ¾in. to ½in.; fine pea from ½in. to ¼in.; and fines, taking in everything under ¼in.; each size being put through their own jigs and shipped separately.

The ore, after dressing, is taken directly in cars carrying about 9,000 lbs., to the Boston and Maine railway siding, and is there loaded into cars for shipment. The distance from the dressing shed to the railway is 2,200ft., and in that distance there is a fall of 180 feet. In the first 400ft. from the shed, the cars are let down 80ft. by means of a counterbalance tramway, the loaded cars going down taking the empties up. The rest of the way has a descending grade of 4½ft. per 100, down which the loaded cars run by their own gravity—the empties being hauled back by horses.

The ore is all shipped in the raw state to different places in the United States, and the first treatment is in converting the sulphur contents into sulphuric acid. The cinders from this process are then smelted and refined, the copper, silver, and gold being all extracted in the final process.

The output of the mine at the present time is at the rate of about 3,000 tons of dressed ore per month, and has averaged this quantity for a year or two back.

The mine, since it was first opened, has produced somewhere about half a million tons of ore, and judging from the general appearance of the vein in the bottom, it will in all likelihood produce as much more, and possibly be a long way from being worked out then. At any rate there is in sight in the mine to-day over one hundred thousand tons of ore, and the vein in the bottom of both shafts is strong and solid as it ever was.

If there is anything in the old miner's theory that a vein continues in depth as far as it does in length, then the ore that may be expected to be produced will have to be counted by the millions of tons.

There is a smelting plant on the property, but it has not been in use for some years, consisting of roasting ovens of a capacity of 1,200 tons a month; two water jacket cupola furnaces, with engines, boilers, fans, etc., capable of smelting 2,000 tons of ore monthly.

MR. J. R. WOODWARD moved a vote of thanks to Mr. Blue.

MR. S. L. SPAFFORD, seconded.

THE SECRETARY then read the following contribution from Mr. A. A. Dickson, Toronto, on the subject of:

Peat Fuel by the Dickson Process.

Peat is a vegetable substance and is produced in several ways, viz:—By the decomposition of forests, by the growth and decomposition of grasses, and the decomposition or disintigration of the Sphagnum moss, but the best and purest peat found in Canada is produced from the Sphagnum moss which grows on ponds and comparatively shallow lakes.

Peat produced by the latter process forms very rapidly, the moss making very rapid growth, and can be found in bloom at the top while it is disintigrating or decaying at the bottom. This moss grows on the top of the water and as it is gradually disintegrated by the action of the water its own weight makes it gradually sink, and if the growth is old and the depth of the water in the lake not too great it will in time descend to the bottom. It is not generally known that the average peat bog is floating on the top of the water like a plank or board, sinking only as its own weight increases, but such is the case. I know of one large bog in the province of Quebec, covering about one thousand acres, which some seventy-five years ago was an open lake. I have conversed with an old resident who when he was a boy used to fish and shoot water fowl on the then lake. At the present time there are three lines of railway running through it. Such has been the rapid

Mr. John M. Jenckes (Secretary Local Committee), General Mining Association of Quebec.

growth of the Sphagnum moss. In some places the peat reaches a depth of nine or ten feet, the whole, with the exception of that portion close to the shores, floating on the top of the water.

Its Calorific value as a fuel.—The elements of peat are essentially the same as coal, save and except the sulphur and phosphorus, viz:—carbon, hydrogen, oxygen, and nitrogen. Its freedom from sulphur and phosphorus is a very essential matter, especially for the smelting of ores. It does not require coking or reducing to charcoal but can be used direct from the machine, although it will stand to be coked and charcoaled equally well with coal. It is extensively used in an air dried state only in Norway and Sweden for the reduction of iron ores, and some of the finest brands of iron are smelted with peat. It makes

more homogenous iron than coal, being very similar to a charcoal iron. In some of the European countries it is being used exclusively for railway purposes. They find it cheaper than coal, the only disadvantage being its bulk. They require specially built vans to carry it in its crude state. It is very dirty to handle as well as bulky, but its freedom from clinkers and cinders and the absence of snlphur, which creates sulphurous acid to eat up the fine boxes and grate bars, is very important. In an experiment made on the Grand Trunk Railway some years ago, the details of which I have before me, air dried peat, containing 20 per cent. of water compared favorably with bituminous coal. The peat stood 80 as to 100 of coal, or one ton of peat being equal to four-fifths of a ton of coal. Compressed peat is however so far ahead of the old air dried material, that it may be classed as coal. Its specific gravity is 1.49 weighing 93 lbs. per cubic foot, anthracite coal weighing 93.5 lbs. per cubic foot, its specific gravity being 1.5, and bituminous coal weighing 86.89 lbs. per cubic foot, its specific gravity being 1.39—thus it will be seen that peat produced by the Dickson process will not occupy any more space than the best grades of coal; consequently it will be readily seen that the one great objection which has prevented the more universal use of peat for fuel has been entirely overcome and done away with. In a very severe test made at the John Abell Engine Works, in Toronto, the details of which I have before me, 457½ lbs. of Dickson's compressed peat was tested against an equal amount of anthracite lump coal. The test was made on a coal burning grate which is not quite suitable for the burning of peat, inasmuch as the surface is entirely too large. The temperature of the boiler house when the peat was used stood at 69 above zero; when the coal was used it stood at 82 above, making a difference in favor of coal of 13 degrees, When the peat was used the weather was dull, when the coal was used the weather was bright and sun-shining,—this to those acquainted with steam is a very material difference in favor of the coal; notwithstanding, the 457½ lbs. of compressed peat kept steam up steady at 85 lbs. exactly two hours, while the anthracite coal kept it steady at 85 lbs. for two hours six and one-half minutes only. Under similar conditions of temperature, with the proper type of grate, peat would have done as well if not better than the anthracite coal.

Compressed peat fuel produced by the Dickson process is equal to coal in its specific gravity, equal to coal in its calorfic power, free from cinder and clinker, cleanly to handle, free from sulphur and phosphorus, contains all the volatile combustible elements found in the bog, cheaply and easily produced, filling the greatest want of the present day. We are looking forward to this new industry keeping millions of dollars in our own country, which at the present time is sent to our neighbors on the south of us; for whom however I entertain the highest regard, but until a closer union is established between the two countries, politically or commercially, we must look to the welfare of our own people. Time will not permit me to go further at present, but if you so desire it I will be pleased to furnish more particulars at another time.

On motion of the Secretary, a hearty vote of thanks was tendered to Mr. Dickson for his contribution, and to Mr. F. P. Buck and his associates of the local committee, for the admirable arrangements made for the reception and entertainment of visiting members of the Association during the meeting.

Excursion to Lake Memphremagog.

On Friday morning visiting members and their lady friends, together with many prominent citizens of Sherbrooke, in all a party of some seventy ladies and gentlemen, participated in a delightful excursion to Newport and lake Memphremagog. Leaving Sherbrooke by the Boston and Maine Railway at eleven o'clock the party reached Newport at noon, dinner being served on arrival in the Memphremagog House. The wants of the inner man having been satisfied, the party embarked on the steamer "Lady of the Lake," which had been chartered for the occasion, and the remainder of the afternoon was spent in the pleasures of a cruise about the lake, the enjoyment of the great picturesque beauty of the scene being greatly enhanced by splendid weather, the bright sunshine being tempered by delicious breezes. A brief stop was made at the foot of the Owl's Head mountain, where the photograph, which we reproduce on another page, was taken. Dancing, too, was heartily indulged in to excellent music provided by a string band. Returning to Newport, the party spent an hour or two before train time, in the enjoyment of a dance at the hotel, or in strolling about the beautiful American summer resort. Everyone returned to Sherbooke benefitted by the enjoyment of an excellent outing, and with a keen appreciation of the care and forethought displayed in all the arrangements made in behalf of the members and their friends, by the local committee.

Coal in Newfoundland—During the past year, according to an official report, valuable seams of coal have been found in the vicinity of St. Georges Bay. The strata in this district have previously been thought to belong to the Carboniferous limestoue and Millstone grit series. Sir William Dawson thinks that these seams are similar to those of Eastern Cape Breton, with which they may be continous under the gulf. A thickness of 27 feet of coal has been discovered, and analysis shows that it is similar in quality to the Cape Breton coal. Large deposits of magnctite exist in the same locality.

SUMMER MEETING AND EXCURSION

—OF THE—

Mining Society of Nova Scotia.

An attractive programme and splendid weather was the means of drawing together a large and representative attendance of the mining men of Nova Scotia at the summer meeting of the Mining Society, which opened at New Glasgow on Thursday, 29th June.

The principal feature of the proceedings on this date was an excursion to the iron mines and works on the East River of Pictou, Pictou county, operated by the New Glasgow Iron, Coal and Railway Company and the Pictou Charcoal Iron Company. The main party arrived by the Halifax train at Ferrona Junction shortly before twelve o'clock, where it was augmented by the Stellarton and Westville contingent headed by President Poole. Here, too, Mr. Graham Fraser, Mr. John F. Stairs, M.P., Mr. D. C. Fraser, M.P., along with other prominent members of the New Glasgow Iron, Coal and Railway Company were waiting to receive and escort the members to the various points of interest. A short run over the East River Railway brought the party to Bridgeville, where a stop was made at the recently constructed works of the Pictou Charcoal Iron Co. On entering the large Cast-House of the Company, one was astonished to find it gaily decked with flowers and evergreens, while a long table fairly groaned with the burden of good things thoughtfully provided by way of luncheon by Mrs. Fraser, Mrs. Chambers, Mrs. Sjosjtedt and other kind ladies interested in the works.

Among those at the table we noticed: John F. Stairs, M.P. (President New Glasgow Iron, Coal and Railway Co.), Halifax; D. C. Fraser, M.P., New Glasgow; Hon. J. W. Longley, Attorney-General for Nova Scotia, Halifax; Hon. A. C. Bell, New Glasgow; His Worship Mayor Jennison, of New Glasgow; Dr. E. Gilpin, Jr., Deputy Commissioner and Inspector of Mines, Halifax; H. S. Poole (Acadia Coal Co.), Stellarton; John E. Hardman (Oldham Gold Co.), Oldham; T. R. Gue (Acadia Powder Co.), Halifax; James Baird (Canada Coal and Railway Co.), Maccan; R. G. Leckie (Londonderry Iron Co.), Londonderry; C. Fergie (Intercolonial Coal Co.), Westville; J. G. Rutherford, Jr. (Acadia Coal Co.), Stellarton; B. C. Wilson, Waverley; George W. Stuart (Truro Gold Co.), Truro; Duncan McDonald (Truro Foundry and Machine Co.), Truro; Wm. Smaill (Londonderry Iron Co.), Londonderry; E. A. Sjosjtedt (Pictou Charcoal Iron Co.), Pictou; G. F. Moncton, Sherbrooke; Simon A. Fraser, New Glasgow; Jas A. Fraser, New Glasgow; J. D. MacGregor, M.P.P., New Glasgow; M. Fitzpatrick, New Glasgow; H. M. Wylde, Halifax, *Secretary*, and B. T. A. Bell (CANADIAN MINING REVIEW), Ottawa.

After ample justice had been done to the excellent collation, and the members had lit up their cigars, Mr. John F. Stairs, M.P. (who presided), gave the usual loyal and patriotic toasts, which were responded to right royally. He then gave the "House of Commons."

MR. D. C. FRASER, M.P., acknowledging the toast, referred to the importance of the development of the iron industries of the province, and to the substantial progress that had recently been made by the companies whose hospitality they were enjoying that day. He dwelt particularly on the good work accomplished by Mr. Graham Fraser, the Managing Director, and his associates of the New Glasgow Iron, Coal and Railway Company.

HON. J. W. LONGLEY, in replying to the toast of the Government of Nova Scotia, said: You have all doubtless heard of Artemus Ward and his skeleton. Artemus was taking a show to Australia, but on the way out on account of the sea air and the excellent provisions, the skeleton got so fattened up that Artemus was compelled to exhibit him as a fat man. His position to-day was somewhat similar. This morning he had started out to visit the Normal School at Truro, but on the way down educational matters had been lost sight of, and in the company of a genial lot of miners he had been fattened up with discourses on mining and the resources of the province. He was glad to have this opportunity of personally inspecting the iron industries of this section of the country. A person making a dismal effort to maintain a conversation with an old maid, after a deathly pause enquired as a starter, "Did you ever see Niagara Falls?" Whereupon she drew herself up primly and replied, "No, I have never seen them, but I have heard them highly spoken of." He had never seen the works at Ferrona and Bridgeville, but he had heard them highly spoken of, and he thought it his duty to be present. The Chairman had placed him in rather an embarrassing position. He had referred to him as an after dinner speaker, and that too when the usual conditions were absent—this being a Scott Act county. (Laughter.) Such an occasion would doubtless call forth the eloquence of his friend Mr. MacGregor, who had been more used to this kind of diet. (Laughter.) The Government of Nova Scotia had rendered some assistance to the iron industry by the construction of the railway over which they had passed to-day. It had done so not in any sense as a favor to the company, but simply because the work of the development of our great iron resources was one which demanded prominent recognition, and in the name of the people and the government of Nova Scotia, he desired to express entire satisfaction with the great progress that had been made. When any work or enterprise of this character is undertaken in any portion of this province the government was free to give to others the same measure of assistance that had been granted to this company. Nova Scotia was a small province, containing between four and five thousand inhabitants, but within its borders were the possibilities of a great industrial and mineral development. With coal and iron and fluxes in abundance side by side, gold in paying quantities, and a large variety of other economic minerals, the possibilities of the future of the province were great. The time had come when the people of the province should realize a sense of the great obligation that is cast upon them to develop these resources. We must dare to be great—to be something more than a province of 500,000 people. Nova Scotia should be made the centre of the greatest mining and manufacturing industries of this continent. He concluded by asking them to drink success to the New Glasgow Iron, Coal and Railway Company.

Mayor Jennison and Mr. Graham Fraser followed.

THE CHAIRMAN, in proposing the Mining Society of Nova Scotia, referred to the beneficial effect the organization had in fostering and developing the mineral wealth of the province. It had, he said, a tendency to encourage investors in mines and capitalists to embark in the various mining enterprises of the province.

MR. H. S. POOLE—The organization which I have the honor to represent is a young one. It is on trial. It has come into the County of Pictou to ask for your suffrages and your consideration. We have been in existence over a year, and have made good progress. I feel assured that the Society is recognized as a possible unit of some weight. He thanked them in the name of the Socicty for the very hospitable reception that had been tendered them, and for the hearty manner in which the company had responded to the toast.

HON. A. C. BELL referred to the growth of the mining industry in Pictou County. It was pleasing to the citizens of New Glasgow, he said, to see some realization of what had been in their early days dreams exceedingly vague of what the county might some day become. In his early days the people were accustomed to compare New Glasgow on the East River with its namesake on the Clyde. A few years ago where the steel works now stand there was nothing but green trees. The coal trade had grown. The building of iron vessels was now one of the industries of New Glasgow. In conclusion he eulogised his old school fellow Mr. Graham Fraser, who by his courage and ability had done so much to promote the establishment of the iron industry in the county.

The toast of "The Ladies" was responded to by Mr. B. T. A. Bell and the Hon. J. W. Longley.

MR. H. S. POOLE in a few well chosen words referred to the work done by the Pictou Charcoal Iron Company, and proposed a vote of thanks to the company for the use of their buildings on the occasion, and for the invitation to inspect their mines and works.

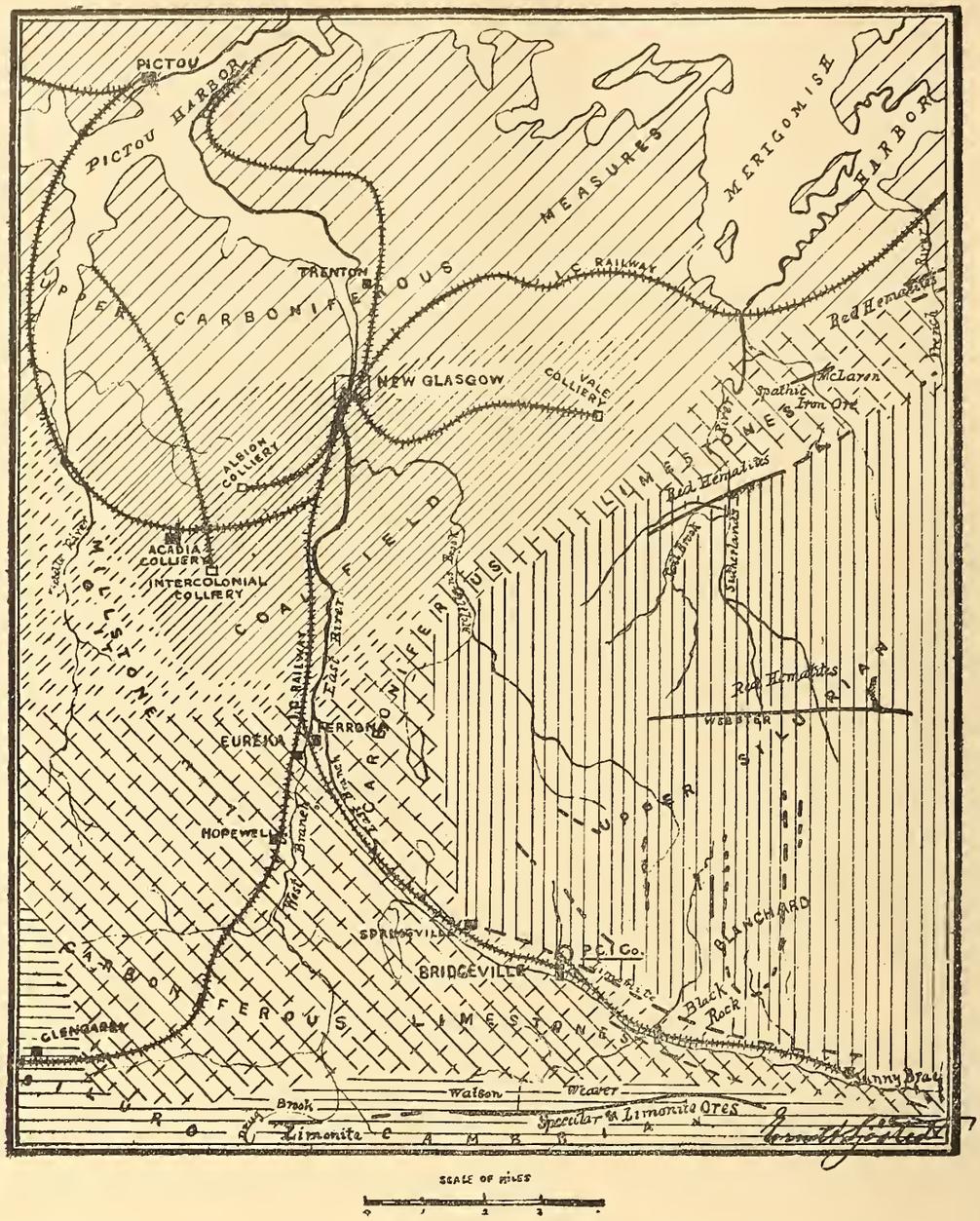
Mr. E. A. Sjosjtedt briefly acknowledged, and the proceedings terminated.

Visit to the Charcoal Iron Works.

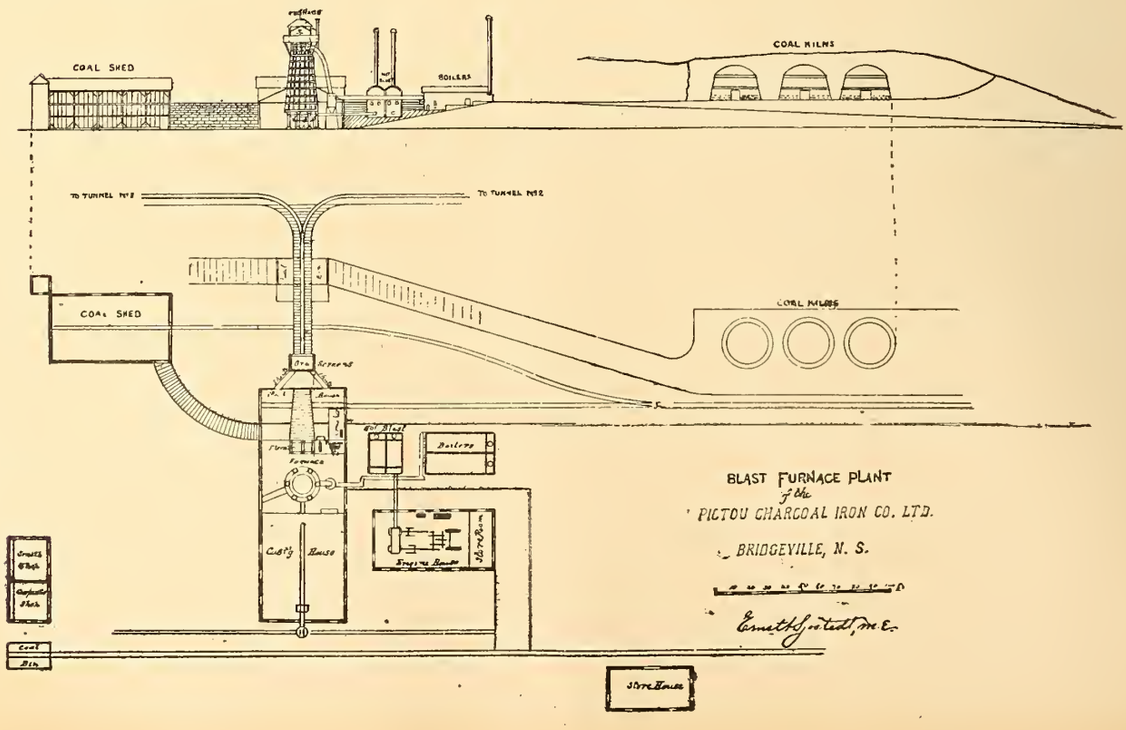
Immediately after the luncheon the members were escorted by Mr. E. A. Sjosjtedt, the Manager, to the mines, kilns and furnace plant recently erected by the Pictou Charcoal Iron Company. The company was organized in 1891 with an authorized capital of $200,000. Mr. W. B. Moore, of New Glasgow, is President, and his associates in the enterprise are all local men.

The iron ores on the north side of the East River of Pictou have been opened up in several places between Springville and Sunny Brae, and are at present worked by the company in two places on the Grant farm at Bridgeville, and by the New Glasgow Iron, Coal and Railway Company, both at Bridgeville and at Black Rock. They are contact deposits between the carboniferous limestones and the upper Silurian measures, and consist of brown hematites, "residuel precipitated found from the disintegration of the older Silurian rocks above," more or less mixed with pyrolusite in form of nodules and mosses, mostly in the hanging wall, but also as veins or crystals in the deposits themselves. On the south side of the river there are the Weaver and Watson speculor ores, but these have as yet not been worked.

The ore deposits worked by the Pictou Charcoal Iron Company being situated but a few hundred feet from the furnace, on a hillside of an elevation of about 100 feet above the same, the mining and handling of the ore is rendered especially easy. Two tunnels have been driven, one on the east and one on the west side, back of the furnace. The latter, or "A" tunnel, goes through a seam or vein of gravel ore easily mined, and 10 to 15 feet in width. After being driven in about 300 feet, a slope was driven up through the ore, at an incline of about 45 degrees south-west, to the surface 60 feet above, which showed up a large body of ore, in some places 18 feet wide.



Showing location of New Iron Mines and Works at Ferrona and Bridgeville, Pictou County, N. S. visited by the Members of the Mining Society.



The ore in No. 2 tunnel is of an entirely different character, being fibrous and compact, and requiring blasting. It is besides richer in metallic iron, nearly free from manganese. This ore was first worked by an open cut on the top of the hill, as it displayed a remarkable deposit of solid limonite, yielding 58% metallic iron, and three to four thousand tons were removed. About 60 feet below this cut the company has now driven a tunnel about 200 feet in the same kind of ore, besides an air shaft (at an incline with the dip of the ore of about 60 degrees) and three different levels, all in ore from 10 to 15 feet wide.

The following analyses will serve to give an intelligent idea of the above mentioned ores:—

	Gravel Ore from No. 1 Tunnel.		Gravel Ore from No. 2. Tunnel.	
Insoluble matter....	12·80	6·75	8·58	5·58
Metallic iron.....	45·02	53·41	54·83	56·57
Metallic manganese.	1·56	1·88	0·20	0·20
Comb water.....	9·45	11·02	10·00	10·90
Sulphur.....	0·05	0·04	0·41	0·09
Phosphorous.....	0·12	0·02	0·03	0·21

The variation in manganese and sulphur is, however, even more marked than the above figures indicate, as crystals of pyrolusite and barite are met with here and there among the ore, without any regularity or warning. The intention of the company is to wash and roast the ore before using it in the furnace; but at present it is simply heap-roasted with wood and charcoal braize at the end of the tunnel track. From here it is afterwards carried on the tramway tracks to the chute above the stack house, and being here dumped on iron rails, placed about two inches apart, and broken sufficiently to pass through these, it falls in a wire netting (10 gauge 3 x 3 mesh) down in the stack house, whereby the dry clay to a large extent is screened through the ore.

The limestone used for flux is quarried at Springville, and is hauled three miles to furnace, costing about 85 cents per gross ton delivered. It contains about 94·0% carbonate of lime, 2·5% carbonate of magnesia, 2·0% insoluble matter.

The buildings consist of offices, stables and store houses, carpenter and blacksmith shops, a coal shed (with a capacity of 40,000 bushels), casting house, stack house and engine house. The shops and furnace buildings are all covered, roof and sides, with currugated iron, painted on both sides with mineral paint. The working plant proper consists of the following structures: The furnace stack is 50 feet high with 11 feet bosh and 7 feet diameter under the hill. The conventional iron shell has been dispensed with and substituted by a crinoline strapping and red brick shell. This, together with the 15 inch fire brick lining is supported by six cast iron columns, and the bosh is surrounded by a boiler plate mantel, and the hearth by a water cooling cast iron jacket. The tuyers, 6 in number, are of bronze and set in water coil breasts. The down-comer has a diameter of 36 inches, and the bustle pipe 15 inches. The top of the furnace is provided with a Weimer patent friction winch and gas seal for facilitating an even distrihution of the stock, and to prevent waste of gas. The hot blast is a modified Cooper-Durham cast iron stove, with 30 V pipes, built in two sections and provided with two combustion chambers side by side, and so arranged that the cold inlet and the outlet of the heated blast, as well as the two combustion chambers, are placed in the same end of the stove. This arrangement was successfully adopted by the manager some years ago at Katahdin iron works mine. Besides economizing space and blast and gas connections, it facilitates maintaining the blast at a high temperature with a small amount of fuel gas, the 2,000 feet of heating surface sufficing to keep the 3,000 cubic feet of air per minute (engine measure) up to 750 degrees to 800 degrees Fahr. The boilers are four in number (30 feet x 36 inches), made of best $\frac{5}{16}$ Dalzell steel, and built in sets of two with separate draft stacks, and independent steam and water connections, and provided with gas valves and combustion chambers similar to those in the hot blast, besides separate grates for wood or coal, in case of shortage of gas. The blowing engine consists of two horizontal blowing cylinders of 5 feet diameter and 5 feet stroke, and a pair of horizontal steam engines, 18 inches by 36 inches each, capable of performing the work in case of necessity.

The elevator comprises a double Whitney hoisting machine and two Wood & Co's safety cages. These, as well as the limestone breaker (a Forster "crusher and pulverizer") are run by belt from a horizontal steam engine of about 15 h. p. capacity. For the handling and weighing of the stock and the pig iron, Weimer patent steel charging barrows and Richle's furnace charging and pig metal scales are used.

Water supply has been provided for by building a 25 foot dam on the Mill Brook, from which the water is conducted 700 feet through 3 inch wooden pipes to the furnace, besides which a reservoir is built (at an elevation of 75 feet above the foundation level of the furnace) for collecting the spring water from the hills above, as well as the water pumped from the river; in case of lack of water from the above mentioned sources. A Northey duplex steam pump (7¼ inches s.c. x 4½ inches w.c. x 10 inches s.t.), is performing this work, and a series of iron pipes are laid to the reservoir, and to different parts of the work, and fitted with valves, hydrants and hose connections in case of fire.

For the carbonization of the wood, 19 brick kilns have been erected at different places. These are of the round (bee-hive) type, each holding 50 cords of wood, and capable of carbonizing 1,200 cords per annum, which will produce 5,000 bushel of coal. Those built in the woods are of the Plattsburg (conical) type, each holding about 30 cords, with an annual capacity of 700 cords of wood, or three thousand bushels of coal. The present coaling capacity is, therefore, about 500,000 bushels per annum, requiring about 1,300 cords of wood. Three more kilns will be built in the spring of 1893, making the total capacity about 600,000 bushels of charcoal, which is the estimated requirement for producing 5,000 tons of pig iron a year.

The wood used for the charcoal making is principally yellow birch, also beach and maple.

Visit to the New Works of the New Glasgow Iron Coal & Railway Company.

After the members had satisfied themselves by a thorough inspection of the works of the Pictou Charcoal Iron Company, the party re-entered the cars and enjoyed a run to the present terminus of the East River railway at Sunnybrae, (a line built by the New Glasgow Iron, Coal & Railway Co.). A brief stop was made at the limestone quarry whence the company derives its fluxes, and then the return trip was made to the new plant at Ferrona. The New Glasgow Iron, Coal & Railway Company was incorporated with an authorised capital of $1,000,000, in 1888 its charter being granted by Act of the Legislature of Nova Scotia. The directors are John F. Stairs, M.P., Halifax, President; Mr. Graham Fraser, New Glasgow; Mr. Frank Ross, Quebec; Mr. John McNab, Halifax; Mr. G. F. McKay, New Glasgow; Mr. J. W. Allison, Halifax; and Mr. Harvey Graham, New Glasgow. The leading spirit in the concern is Mr. Graham Fraser who is managing director. It controls in fee simple and under lease a large area of mineral lands on the East River. The ores mined are brown and red hematites and specular iron ore. Last year the furnace, which is situated at the forks of the east and west branches of the East River, (within easy distance of the Pictou coal fields) was completed. It is 65 ft. high; bosh, 25 ft. 6 in.; hearth, 9 ft. 9 in. Its yield when running to full capacity is about a 100 tons a day. The establishment is fitted with all the most modern plant and appliances, including a battery of coke ovens of the Coppee pattern said to be the first of the kind built in America.

We present our readers with a drawing showing exterior view of the works, and in our next issue will devote some space to a more detailed description of the buildings machinery and equipment. Altogether the company employs at present about 400 persons. The output just now is understood to average about 80 tons of high grade iron per day. A considerable quantity of the product is consumed by the Nova Scotia Steel & Forge Co., New Glasgow, (in which members of the company are largely interested) and other provincial foundries. The members of the Society visited in turn the ore washing plant, the cast house, engine and boiler rooms, coal washing equipment, coke ovens, etc., and all expressed themselves as highly pleased with all that they had seen. A little after six o'clock the members took train for New Glasgow where the main body registered at the Vendome.

Reception in New Glasgow.

In the evening the members gathered in Bell's Hall, New Glasgow, where by invitation of the local committee a goodly company of ladies and gentlemen from New Glasgow and neighborhood had assembled to meet them. The platform was tastefully decorated with plants, while the walls were hung with various maps, plans and drawings. Among these were noticed the original plans and profile of the Albion Mines Railway, made by Peter Crerar in 1834, together with his designs for bridges, culverts, etc.; also a large scale map of the Pictou coal field prepared by the Geological Survey of Canada in 1869, together with another made from investigations by Mr. H. S. Poole, M.A., F.G.S., and other membesr of the staff of the Acadia Coal Company, showing many changes and corrections in geological data presented by the old Survey map. An interesting display of safety lamps, gas testing apparatus and other mining exhibits claimed attention. These were in charge of Mr. J. Geo. Ruthcrford, Assistant Manager of the Acadia Coal Company and a staff of assistants, and iucluded;—

I. Biram's Anemometer in use 40 years ago.

II. and III. Biram's Anemomcter in use at present time, and Davis' Patent Self-timing Anemometer.

IV. Liveing's Patent Gas Indicator for detecting small percentages of fire damp by means of electricity.

V. An old compass used for surveying the mines many years ago.

VI. A $\frac{7}{16}$ in. chain which had sustained a weight of 6 tons, 7 cwt. without breaking.

VII. A ½ in. wrought tube rent by an ordinary detonator exploded inside.

VIII. Samples of the various wire ropes, ordinary rope, Lang's lay and Elliot's patent locked coil.

IX. The apparatus for use in deleterions gases, consisted of a smoke absorbent. B. Loeb's patent breathing arrangement, and the Fleuss breathing dress, consisting of a steel cylinder into which oxygen is compressed up to 260 lbs. per sq. in., affording a supply sufficient for four hours. Over the cylinder is a filter divided into four compartments and filled with alternate layers of tow and caustic soda. The exhaled air passes through this filter, the carbonic acid gas is absorbed by the caustic soda (the tow being present simply for dividing the air), and the residue passes into a bag of about 40 cubic inches capacity placed on the chest, and is here replenished with fresh oxygen from the cylinder as occasion may require.

X. An ambulance and basket of appliances in cases of accidents.

XI. The lamps were Davy, Stephenson and Clanny, all invented about 1816-18; all the modern lamps, Mueseler, Bonneted Clanny, Marsant-Ashworth's patent Hepplewhite Gray Deputy's lamp; Pieler lamp, which burns alcohol and detects one-fourth of 1 per cent. of fire damp; Thorneburry lamp, burning a mineral oil of high flashing point, and providing a light equal to from 1 to 1½ candles, whereas the Davy gave a light of one-fifth of a candle, and lastly, portable electric lamps both primary and secondary.

XII. A small portable low-tension exploder for firing shots in the mine.

XIII. A patent multiple wedge for bringing down coal.

XIV. A patent self-lubricator for box wheels.

On motion of Mr. H. S. Poole, the Hon. A. C. Bell was moved into the chair.

HON. A. C. BELL said: Ladies and gentlemen, I congratulate myself on being honored in presiding over a meeting of citizens of New Glasgow, whose privilege it is to welcome to our town the Mining Society of Nova Scotia. I congratulate the citizens on the happy occasion of this meeting. They are honored by having as their guests the members of this society, and in receiving men who have gained eminence in all departments of the mining activities of the province.

To-night we welcome those who have taught us how to extract the all powerful yellow metal from that portion of our province which seems to offer least for the benefit of man, and to be of almost no value to the country. Gold is powerful, but more powerful is wealth of iron and coal, and to-night we have the honor of receiving as our guests the men who have achieved success and acquired distinction in the large operations of our collieries and iron works.

Our province owes much of its wealth and much of its position in the Dominion and in the world to the labor of the mining engineer, and we may well congratulate ourselves that we are favored at one of its earliest meetings to receive the members of this, the Mining Society of Nova Scotia, as our guests. Not great agriculturally, Nova Scotia must acquire wealth, population and position through the development of her mines and manufactures and her fisheries, and our progress as a people depends directly on the amount of brains and ability brought to bear on the conversion of our stores of mineral wealth into commodities. In this work most important to us we will owe a great deal to the Mining Society, and to it we wish all success. The progress of this province, although not very rapid, has been steady and satisfactory, and I give a few figures to show that progress. In the last 20 years our output has increased as follows:—

Coal	from	1,000,000 to	2,000,000 tons.
Iron Ore..	"	3,500 to	57,000 "
Gold	"	11,000 to	23,000 oz.
Gypsum ..	"	120,000 to	160,000 tons.
Copper Ore		Nil	900 "

In Nova Scotia great progress has been made, and in Pictou County, where we now gather, much more proportionate progress has been made in the province as a whole.

Coal Mining in Pictou County on a systematic method commenced about 1818 at Albion Mines, and some years later a small lot of iron ore was smelted. This experiment was not repeated. The iron manufacture in Pictou County was first commenced at the works at Albion Mines for the use of the Mining Association about 1837-39. At these shops a little work was done for the public, but public patronage was not desired.

The first foundry at New Glasgow, that of William Fraser, was opened in 1857. Ten years later Isaac Matheson commenced the foundry and machinist business, which still continues under the name of I. Matheson & Co.

In 1872 the Nova Scotia Forge Co. came into existence on a small scale, and as is well known has grown into the Nova Scotia Steel and Forge Co., with a reputation wider than the Domininn.

At about these and later dates iron working establishments for the manufacture of stoves, bridges and agricultural implements have followed one another, until now the business has assumed large proportions. There are in New Glasgow eight establishments, employing 600 hands, paying $200,000 in wages and producing $750,000 of product each year.

There are now at Ferrona and Bridgeville two plants of most improved character for the production of ordinary and of charcoal pig, thus producing in our midst the raw material for all iron working business, of best quality. There can be no doubt that in future the product of these furnaces will be more and more utilized.

For many years, from about 1825 to about 1885, for a period of 60 years, the great industry of wooden ship building was a mainstay of business in New Glasgow, but for many years no vessel has been built here. Now in this year, 1893, an iron steamer is being built in the long deserted ship yard by I. Matheson & Co., two of the members of the firm being members of the firm of J. W. Carmichael & Co., which for many years did the principal business in wooden ships. Let us hope that the steamer now building is but the first of a fleet which will make the name of New Glasgow familiar and famous in as many seas as did the old time clippers of the days of white wooden ships.

Nova Scotia has, as we are frequently reminded, great wealth of mineral, she has an ingenious, apt and well

endowed race of men, and both in body and mind these are well fitted to compete with all comers.

All she requires is trained and educated management, and capital which will come as soon as it is evident that good investments are offered. In conclusion, I have much pleasure in extending a cordial welcome to our visitors, with best wishes for the success of the Mining Society of Nova Scotia. (Applause.)

H. S. POOLE—As a native of Pictou County, it gives me additional pleasure to acknowledge this most gratifying reception you have given to our Society on its first visit to New Glasgow, and I am sure, from the address of Mr. Bell, all here who are natives of this County, cannot but be flattered with the position in which he puts us. He himself very worthily represents New Glasgow in the interests of mining at this meeting, for he is a namesake and descendant of the first practical miner who came into the county. The name of Adam Carr appears on many of our mining plans in connection with the early workings of 1815 to 1827.

As for the objects and hopes of our Society, Mr. Bell has touched on some of them, and in coming here we hope to gain your interest as well as to enjoy a pleasant outing. "All work and no play makes Jack a dull boy," we recognize, and therefore do not confine our meetings to the reading only of papers, and discussing matters of grave moment. But if we did, we have had in a paper lately read by your fellow townsman, Mr. W. G. Matheson, one of exceptional value and so practical that alone it would justify the formation of such a society as ours.

But in holding our meeting here in New Glasgow we have yet another object in view. Would you be surprised to hear we desire to have it known that we are not engaged in a criminal occupation, that we are not necessarily all criminals because of our occupation, and yet in the matter of legislation we are treated as criminals, we are not consulted in the preparation of legislation that specially affects us. We do not doubt that the alterations in the mining laws are made with the best intentions for the preservation of life and property, but the amendments made are not always practical, their bearing is sometimes wider than was intended, and we ask for your interest to have this grievance removed, that alterations in mining laws should only be made after careful consideration and consultation with those who are most interested in the mining industry.

We have here on the tables and walls maps and articles connected with our early mining history. The large plan and sections were made by Mr. Peter Crear, in 1834-8, for the first railroad built in Nova Scotia, and not only are they worthy of study on account of their age and neatness of execution, but because they were made by one who had never seen a railway. When they were sent to England on approval they were accepted without alteration, and Mr. Crear was put in charge of the construction. Then we have a series of safety lamps ranging from the dim Davy to the modern Thornbury, giving seven times the light and with it the strong electric portable lamps with primary and also secondary cells.

Then there is a series of anemometers, one of which is forty years old and still serviceable; and presently we shall show you the Fleuss apparatus that enables a man to enter noxious gases and yet breathe oxygen which he carries with him in a compressed state.

On the wall opposite there is a geological map of the Pictou coal field as it was supposed to be twenty years ago, and another map as some of us now think its structure should be shown. I am glad of this opportunity to refer to matters geological, for gentlemen connected with the promising copper industry in Cape Breton have, at this meeting joined our Society, and it is to a discovery made by Mr. H. Fletcher, of the Geological Survey (applause) that we are indebted for this addition to our mining interest.

I would again thank the people of New Glasgow for the exceedingly flattering reception given to the Mining Society of Nova Scotia.

The Hon. J. W. Longley having followed with a few appropriate remarks, the Chairman called upon the Rev. George Patterson, D.D., New Glasgow (the historian of Pictou County), who contributed the following address :—

The Early History of Mining in Pictou County.

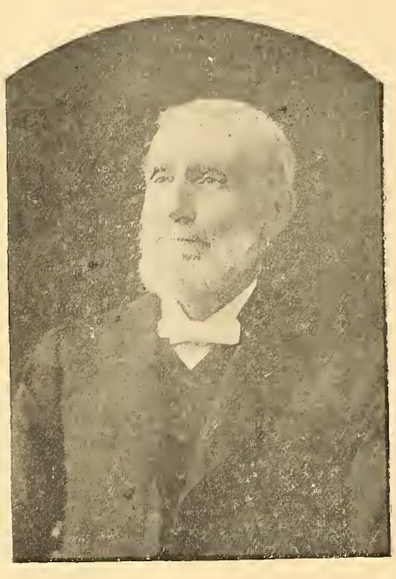
REV. DR. PATTERSON—Coal was first discovered in this county in the year 1798, on a brook near Stellarton, which passed through the rear of the farm lots of the Rev. James McGregor, D.D., which fronted on the East River at the bridge and northward, and of William McKay, Esquire, which adjoined it to the north. In the same year William Fraser, surveyor, carried a sample to Halifax to the governor, Sir John Wentworth, who sent him with it to Admiral Sawyer, who ordered a small cargo to be sent to Halifax. This was done but it did not prove of good quality. In the following year occurred a contested election for the county of Halifax, then including Colchester and Pictou. The last day's polling was held at the East River, when the doctor entertained the candidates and some strangers to dinner, and as a curiosity he had prepared a fire of the coal dug out of the brook. The event excited quite an interest, partly from its novelty and partly from its bearing upon the future interests of the Province.

Soon after the doctor and some of his neighbors took out licenses from the Government to dig coal, but he was the first in the county to use it as fuel. He first opened a pit on what is still known as the McGregor seam; discovered on his own land, and used the coal in his house. This was as early as 1802. From that time he regularly in the autumn got out his winter's supply, and sometimes sold some. Previously the blacksmiths had used charcoal in their work, but now John McKay, of Pictou, commenced sending lighters up the river, and took the coal to town for use in his smithy, and the blacksmiths in other places followed the same course.

I may explain here that in the earliest grants of land in the Province, the mines of gold, silver and coal are reserved to the Crown. At a later date lead and copper were included in the reservations, and still later, in the year 1808, iron, and in fact all other minerals. It will thus be seen that over a large part of the country the iron deposits belong to the proprietors of the soil, but in all cases the coal mines are the property of the government, and are worked under lease from it.

In the year 1807 John McKay, squire's son, but usually known as collier, obtained a license to dig for the inhabitants and at a later date to export. The former licenses, as I understand, only authorized parties to dig for their own use. He and his father commenced working a small three-feet seam on the farm of the latter, but it soon became exhausted. They then searched farther and found what has since been known as the "Big Seam," though they did not know its value. John continued to work at this for some time, selling the coal at the pit's mouth, and sending it down the river in lighters. A demand sprang up for it during the war, to supply the garrison, navy and inhabitants of Halifax, so that in the year 1815 we find 650 chaldrons exported.

After the peace the price fell to half its former rate. Owing to this, and perhaps other causes, Mr. McKay failed, and was imprisoned, while his property was seized by Hartshorne, of Halifax, who had been furnishing him with supplies. The workmen being unpaid, the latter



Rev. George Patterson, D.D., New Glasgow, (the Historian of Pictou County).

tried to compromise with them, but they persisted in claiming full payment of what was due. Mr. Adam Carr, who was one of them, joined with Edward Mortimer, of Pictou, then one of the most influential men in the Province, and by his influence the government was induced to let the mines to the highest bidder. In that way they obtained the lease of them in the year 1818. They worked together till the death of Mortimer in the following year, when, on the 3rd of November, the lease was transferred to George Smith and William Liddel. Smith and Carr worked for a time in partnership, but afterward separated, when the latter got the whole into his possession, and continued to mine for several years, raising the coal with a gin-wheel by horse power, selling it at the pit mouth and carting it to the river, where it was sent away in lighters. By a report to government it appears that from 1818 to 1827 the amount of coal raised in each year averaged over 2200 chaldrons.

In the year 1825 the British Government leased all the reserved mines of Nova Scotia for sixty years to the late Duke of York, excepting, of course, those which had been already leased to other parties. The Duke's lease was transferred to Messrs. Rundell, Bridge & Rundell, the celebrated London jewellers, in payment of his debts, and from them to the General Mining Association, in which I believe they were large shareholders.

On obtaining their lease, they sent an agent to the Province to explore for minerals, and on his report resolved to commence operations at the East River. They purchased Mr. Carr's lease, and having about the same time secured the rights of the lessees of the Sydney mines, they thus became possessors of all the coal mines of the Province.

Early in the summer of 1827 they sent out Mr. Richard Smith, intending to commence operations both in coal and iron mining. In June a vessel arrived in Pictou bringing machinery and implements, with colliers, engineers and mechanics. Without delay he commenced sinking new shafts to the depth of 212 feet and erecting the proper machinery for working the coal mines on a larger scale and in a more scientific manner than hitherto. On the 6th September their first coal was raised, and on the 7th December a steam engine of 20 horse power was in operation, the first ever erected in the Province. A foundry was established in which were cast rails for a tramway, which they constructed from their works to a point a little below New Glasgow. Here chutes were erected, and vessels drawing not more than six feet of water were loaded. To load larger vessels they constructed lighters, in which the coal was conveyed to South Pictou, or the Loading Ground, as it was commonly called, at the mouth of the river. They also employed two steamers, a small one built in Pictou for the river navigation, and a larger one from England for coasting and carrying the coal to market. The first of these, which made her first trip on the 17th July, 1830, was the first steamer that ever plied in our harbor. This plan of loading being slow and tedious, they next resolved on deepening the river. For this purpose they obtained an Act of the Legislature, giving them full authority over the river, so that no vessel drawing over six feet of water was to enter it without their permission, and only on paying toll to them. But in passing the Act, the Assembly, which had resented the conduct of the British Government in transferring our mines and minerals, added a clause to the effect that the bill was not to be construed as admitting the right of the home authorities to dispose of our mines in the way they had done. In consequence of this the Act was disallowed at Downing Street, and at the same time a feeling of opposition having arisen in the country against such a monopoly, the scheme was abandoned.

The company continued therefore to ship their coal in the manner described for several years, but the demand was greater than they could supply, and the long delay of vessels in receiving their cargoes was a great discouragement to the trade. In the meantime the use of locomotives or railroads had been tried successfully in England. Accordingly it was resolved to build a railroad from the East River to the Loading Ground for the carriage of their coal in that manner. The road was laid out in the year 1834 by the late Peter Crerar, and work began upon it in 1836, but it was not opened till the 29th September, 1839. The engines used upon it, of which there were three, named the Sampson, Albion and Hercules, were built by Timothy Hackworth, who competed with Stephenson at the first trial of locomotive engines in England. They were, for their size, powerful though slow, and continued to do duty till lately. One of them, the Albion, is now on exhibition at the World's Fair at Chicago. This railroad, which was about six miles long, was extremely well built, but in the year 1886 the use of it was abandoned, it being found more convenient to ship over the government lines.

When the Association commenced operations, they designed to work the iron, as well as the coal deposits, known to exist on the East River. For this purpose, soon after they had completed their arrangements for raising coal, they erected a small blast furnace near the mines. They mined some ore from a bed of red hematite, at Blanchard, and collected a quantity of boulders of limotite in the neighborhood of Bridgeville, principally on the farm of James McDonald, afterward purchased by them. But the vein was not discovered, and on attempting to smelt the ore thus collected, through some defect in their mode of operation, they were unsuccessful. Efforts were made by various explorers to find the vein. The first who claimed to have found it was Dr. Honeyman, about 20 years ago, but his claim was disputed by Mr. Hartley. It was left to Sir Wm. Dawson, two years later, to define the position of the vein, which he found to be at the junction of the Carboniferous and Silurian formations. No further attempt was made to develop the ores till within the last two years, when the works at Bridgeville and Ferrona, which the Society have had to-day the opportunity of examining, were commenced.

The Association spent large sums in developing their coal mines. At that time few of the inhabitants of the Province, except in the city of Halifax or near the coal mines, used coal in their dwellings, and there were few steamers or steam engines, so that the home market was limited. But such was the demand in the United States, that their difficulty was in finding means to raise or transport a quantity sufficient to supply it.

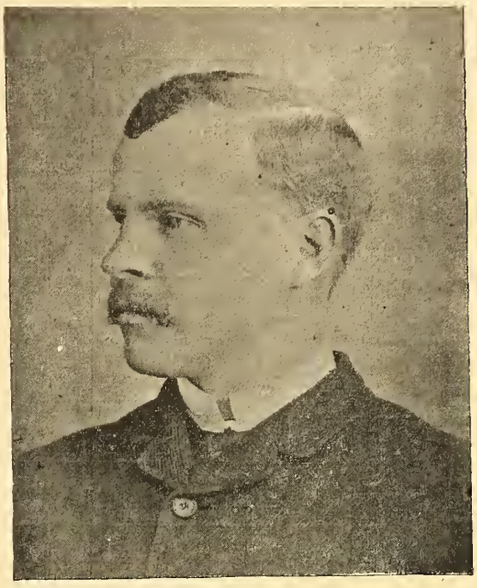
The Association suffered much at different times from fire or explosions. The worst of these took place in the year 1832, and 1839. These involved such destruction of the works that pits which had been equipped at great cost had to be abandoned, thus subjecting the Association to heavy losses.

In the year 1856 the monopoly of the General Mining Association was abolished. This immediately led to great activity in exploring for coal. The result was the tracing of the seams toward the westward, and the commencement of mining at Westville, and at a later date the discovery of workable seams at Thorburn, and the commencement of mining there.

But our subject is the *early* history of mining in this county, and as this change introduced a new era in coal mining, our task may be considered accomplished, and the history of the subsequent developement of our mining industry must be left to some future examiner. (Applause.)

On motion, a very hearty vote of thanks was conveyed to Dr. Patterson for his very valuable contribution. Thereafter the company enjoyed the evening in social intercourse, in examining the many interesting exhibits, and before finally adjourning in a dance.

Hon. A. C. Bell, New Glasgow.



J. Geo. Rutherford, Stellarton, N. S.,
Asst. Manager, Acadia Coal Co.

Mr. E. A. Sjosjtedt, New Glasgow, Manager,
Pictou Charcoal Iron Co.

Chas. Fergie, Westville, Manager,
Drummond Colliery.

Meeting in the Vendome--The Duty on Mining Machinery.

On the return of members from the Reception, a business meeting was held in the Vendome Hotel, New Glasgow. There were present: John E. Hardman, Oldham; Duncan McDonald, Truro; R. H. Brown, Sydney; C. Fergie, Westville; T. R. Gue, Halifax; Geo. W. Stuart, Truro; B. C. Wilson, Waverley; James A. Fraser, New Glasgow; Dr. E. Gilpin, Halifax; W. G. Matheson, New Glasgow; Wm. Smaill, Londonderry; John F. Stairs, M.P., Halifax, D. C. Fraser, M.P., New Glasgow; Hon. J. W. Longley, Halifax; B. T. A. Bell, Ottawa; and H. M. Wylde, secretary. In the absence of Mr. Poole, President, Mr. J. E. Hardman, Oldham, was called to the chair.

The minutes of last meeting were read and confirmed.

A proposed amendment to Constitution was, owing to the absence of Mr. Poole, the proposer, held over until next Quarterly General Meeting.

Mr. T. R. Gue, chairman of the sub-committee appointed to consider a statement of the various classes and kinds of mining machinery manufactured in Canada, presented his report, copies of which, before being adopted, had been mailed for revision to Messrs. Matheson Robb and McDonald and other manufacturers of mining machinery.

Mr. B. T. A. BELL having explained what action had been taken in the matter by the General Mining Association of Quebec, the statement was adopted.

Mr. JAMES BAIRD, seconded by Mr. C. Fergie, then moved the following resolution: "That the various members of parliament for Nova Scotia be requested to exert their influence to have the language of the Act relating to the free importation of mining machinery changed to read as follows.: "That all tools, machinery and appliances for mining, quarrying, smelting, refining and concentrating and other processes, for the mining, extraction, and treatment of ores and minerals, of a class or kind or pattern not manufactured in Canada, be admitted free of duty, and that a copy of this Resolution be forwarded to the Honorable the Minister of Customs at Ottawa, and to the General Mining Association of the Province of Quebec."

After discussion the motion was put to the meeting and carried unanimously.

The meeting then adjourned until eleven o'clock next morning.

The Introduction of Amendments to Colliery Legislation Discussed.

Meeting was called to order in the Vendome Hotel, Friday, 30th June, Mr. H. S. Poole, President, in the chair.

Mr. B. T. A. BELL moved the consideration of the question concerning the appointment of a committee to interview the premier in reference to the introduction of mining legislation without proper consideration and hearing of proposed amendments.

Mr. G. W. STUART seconded.

Dr. E. GILPIN—I have no hesitation in saying that I do not believe in making legislation until it is first discussed from the three standpoints: 1st. The Government. 2nd. The men. 3rd. By the owners—so you would have all the different interests involved in it. In the recess of the legislature each party could come before the Government and give their views on any proposed legislation.

Mr. H. S. POOLE said—I feel very strongly on this question. We have had amendments made from time to time to the Mining Act, by parties who have had either an axe to grind or who fancied they were born legislators—legislation which it was thought would rectify more or less certain evils. I have had a finger in it myself. The reformers have sometimes seemed to think that when a man was killed in a particular way, that regulations could be provided by legislation which would prevent any accident of that character occurring again. We have had a great deal of legislation, much of which has never been put into operation. I maintain that legislation which is not put in force should be wiped out. An act of parliament should be carried out or dropped.

In 1872 when the original Mines Regulation Chapter was drafted before it came before the legislature, copies were distributed and it was discussed by those interested. That practice should be carried out with respect to amendments to both Acts. Last winter legislation was passed and the Commissioner of Mines had not an opportunity of conferring with those interested in mines; he was not consulted, the legislation was introduced entirely without his knowledge. Dou you think that that was respectful to the position which he occupies? I consider it was not. He might have said to the House, I am the Commissioner of Mines, and no legislation should be admitted into this House without passing through my office; if the Government chooses to ignore me I will not be the Commissioner any longer. It is due to me and to my position that legislation affecting mines should be submitted to me first.

The Mining Society expressed a hope that this would be done, but although that hope was not realized, I am glad for my part to think that the indifference in question was not as some suppose an intentional slight to our society. A little consideration will, I trust, make this clear to all. The snub intentional could not be for the ability to conceive it would carry with it a perception of disrespect to the Honorable Commissioner of Mines in the introduction to the Upper House of legislation touching his Department without consultation first had with him. To snub intentionally and ignore him wilfully would go together. To ignore wilfully would imply the belief in his usefulness, while all who frequent the Mines Office know the broad grasp he has of his Department and the urbanity with which all are received by him.

That he himself did not so regard it is I think evident, so also with the passing over of himself and his Department, it was no indication of the Upper House doubting his usefulness. The offence then, if you can call it one, was one of omission and not of commission. I do not think that there was any premeditated intention of ignoring this Society last winter. I do not think it was seen that to ignore our Society was also to reflect on the Commissioner of Mines, for it was tantamount to saying to the public the Commissioner of Mines is not fit for his office; we no longer trust the Commissioner or the work of his Department, and we allow anybody in the Upper or Lower House to introduce any amendment to the mining laws at the last hours of the session, let it pass and take its chances as to whether it is a fit and proper amendment to meet the cases supposed. I think the matter should be laid before the Executive Council, and that we should ask that legislatiou affecting one of the established Departments should not be allowed to pass when introduced by a private member after the House is in session, unless it has been previously submitted to the Government during recess and an opportunity given for those interested to consider it.

I would like very much to have the experience of Mr. James A. Fraser, because when he was a member he took a great deal of interest in the mining legislation of this county. This is certainly a matter which should be redressed.

Dr. E. GILPIN—What I understand from your views is that the Government should make no alteration in the mining acts without it came from the Mines Department?

Mr. POOLE—Quite so, and that there shall be a general opportunity given for discussion and to hear the views of those affected if it be a question between men and masters, or royalty payers and the Government. Then the legislation should be endorsed by the Department of Mines. The antagonistic parties should have an opportunity of being heard before it is introduced on the floors of the House. It has been disrespectful to the Government, it has been disrespectful also to the Commissioner of Works and Mines, that the work which should specially appertain to his Department has not passed through his hands.

Mr. JAMES A. FRASER—I would suggest that in view of any legislation to be introduced next winter that notice of it should be published in the Royal Gazette or daily newspapers.

Mr. POOLE—Provided the Department of Mines approved of it.

Mr. JAMES A. FRASER—You would not get the Government or private members to agree to that. You might get by common consent a ruling that for legislation of that kind due notice should be given. Notice must be given in the Canada Gazette of certain kinds of legislation which goes through the Parliament of Canada. You might get a similar rule in regard to mining legislation.

Mr. POOLE—Should it not be a Government measure? Surely any legislation affecting a matter of which the Government has a Department should be a Government measure.

Mr. JAMES A. FRASER—They would not submit to it. The Government has got to be politic in its movements.

Mr. POOLE—But then it has made some of these amendments thinking they were pleasing to certain voters. I contend the full bearing of some amendments was not seen, nor when it was thought a benefit was being done to one class it was hurting others. For instance, I contend that Mr. Fielding did not see the full bearing of the legislation last winter.

Mr. JAMES A. FRASER—I agree with you with regard to publicity of mining legislation before its introduction into the House. Your object is to get any proposed legislation made public previous to the meeting of the legislature for the purpose of information and discussion and hearing all parties who are interested in connection with it. What we want to get at is that.

Mr. POOLE—A committee might wait upon the Government and urge upon it to make all mining amendments Government measures, and that the same should receive the sanction or consideration of the Department of Mines before being introduced.

Mr. JAMES A. FRASER—Notice of the legislation should be published for at least three months in the Royal Gazette or in a couple of newspapers. It would simply be following out the lines which should be laid down in regard to municipal laws of the towns and counties. Some of this legislation had taken its rise in the Provincial Workingmen's Association, and if we can get the Workingmen's Association to agree with us, and we ask their co-operation they will certainly agree with us. They want publicity as well as we do.

Mr. POOLE—Because when an Act of the Legislature is improperly worded they do not know when it is going to pinch them or pinch us. I have always been perfectly satisfied where a matter was clear and just to leave it to the workingmen.

Mr. JAMES A. FRASER—Go to those men frankly and ask them for their co-operation and explain it to them, and I have no hesitation in saying they will be one with us. When Mr. Drummond was before the Legislature he stated: "I am entirely opposed to the managers from the men's standpoint. I do not come here in a double capacity, I come here in an advocates capacity," but I am satisfied you will find him reasonable in this matter before a delegation.

Mr. R. H. BROWN—I also remember his saying on one occasion in the Commissioner's Office, "I am here as the paid agent of the Provincial Workingmen's Association."

The resolution was then put to the meeting and carried, the President, nominating a deputation to interview the local government.

Mr. B. T. A. BELL then moved a vote of thanks to the various gentlemen composing the local reception committee, who had so thoughtfully provided for the entertainment of the members and the success of the meetings.

Mr. J. E. HARDMAN having seconded, the motion was put and carried unanimously.

Other Excursions.

During the morning parties of members were driven to the top of Grant's Mountain, and greatly enjoyed the magnificent view of the surrounding country. Others visited the well equipped establishment of the Nova Scotia Steel and Forge Co. at New Glasgow, the new steel steamer being built by Messrs. Matheson & Co., and others, at the invitation of Mr. Fergie, the Drummond colliery.

Note on an Occurrence of Manganese and Zinc Ore in Nova Scotia.

By E. Gilpin, Jr., LL D., F.G.S., F.R.S.C., etc.
Deputy Commissioner and Inspector of Mines, Nova Scotia.

[Paper read before the Mining Society of Nova Scotia.]

These brief notes are intended only to bring to the notice of the members of the Society an occurrence of manganese in a form which is, I think, new in this Province, and of an interesting specimen of zinc ore.

In the case of the former, samples of rock were brought to me from Whitehead, in Guysboro' County, which had excited the curiosity of the discoverer by the readiness with which pieces of it fused in an ordinary fire. This ready fusibility of certain rocks is not generally known, and is usually considered a mark of the presence of some valuable metal. In this case the metal was for some reason unknown to me considered to be zinc. The rock, a sample of which is submitted, is light brown and gray in color, weathering to a light drab. It is hard, brittle and sub-granular in texture. The sample shows a folding in the shape of the letter S, and has crevices, apparently due to the folding, filled with crystalline matter slightly darker than the surrounding rock.

The samples, although resembling in a general way the rocks called felsites, had features of novelty about them, and I sent some to Mr. Leckie, manager of the Londonderry Iron Works, and the analyst of the company, Mr. Smaill, was kind enough to make a partial analysis of it. He reports that it contained:—

Silica	70·25
Alumina	15·25
Manganese oxide	9·25
Iron oxide	Small quantity
Lime	do
Magnesia	do
Zinc	none

The remainder being probably moisture, with some potash, soda, carbonic acid, etc.

Having disposed of the zinc theory, the presence of manganese became interesting. Presumably the manganese present is in the form of a bi-silicate of manganese, such as rhodonite, and that the greyish red or brown color of part of the sample may be due to the partial penetration of the rock by some carbonate of lime, manganese, etc. Dana, in his mineralogy does not give any analyses of the varieties of the silicates in any way resembling that under consideration. Allowing for the presence of a certain amount of free silica, as is usually the case in rocks of the class under consideration, the analysis given by him of orthoclase, present a parallelism with the exception of the absence of potash and the presence of manganese, the typical composition of this mineral being:—

Silica	64·60
Alumina	18·50
Potash	16·90

It would appear probable that the manganese has replaced nearly all the potash. The addition of moisture and free silica, and the replacement of part of the alumina and potash by the small quantities of iron, lime and magnesia would give a compound almost identical with that before you. All the analyses of orthoclase given on pages 356 to 361, of Dana's Mineralogy, have silica contents of from 64 to 75 percentum, and contain iron, magnesia, lime, soda, etc., in varying amounts up to about four per cent.

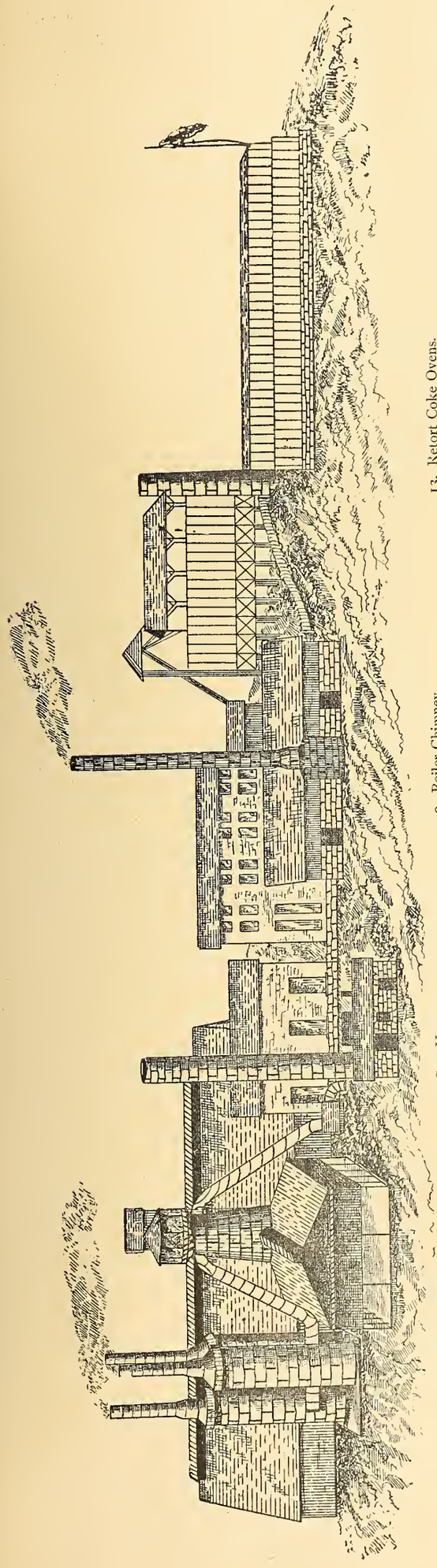
The same may be said of the possibility of the manganese having replaced the soda in an albite, the typical composition of which is:—

Silica	68·6
Alumina	19·6
Soda	11·8

In this case also the other foreign oxides would have replaced part of the soda and alumina.

It appears that feldspars are altered by the action of waters containing carbonic acid, or alkalies, or rendered acid by the decomposition of sulphurets. The completion of a course of decomposition of feldspar by the agency of

PLANT OF THE NEW GLASGOW IRON, COAL & RAILWAY COMPANY, Ltd,
At Ferrona, Pictou County, N. S., Visited by the Mining Society.



1. Blast Furnace.
2. Blast Tower.
3. Hot-Blast Stoves.
4. Slack House.
5. Cast House.
6. Engine House.
7. Stand-Pipe.
8. Blacksmith's Shop.
9. Boiler Chimney.
10. Coal Washing Building.
11. Coal Storage Tower.
12. Boiler House.
13. Retort Coke Ovens.
14. Pig Iron Track.
15. Cinder Track
16. Slack House Track.

Mr. Harvey Graham. New Glasgow, New Glasgow Iron, Coal & Railway Co. Ltd.

Mr. W. B. Moore. Jr., New Glasgow, President, Pictou Charcoal Iron Co.

water containing carbonic acid is the formation of a kaolin, or hydrous silicate of alumina; but there are many intervening steps, modified by circumstances. Thus the presence of lime, iron, etc., leads to changes in composition, forming one or more links in the process. In the case before us it would appear that the mineral most convenient or most applicable has replaced the potash or soda, and marks an important change in the ultimate decomposition of the rock.

The following analysis given by Dana, of minerals resembling most closely in their silica and alumina contents the sample from Whitehead, may be of interest:—

	Silica.	Alumina.	Iron Sesq. Oxide.	Magnesia.	Lime.	Soda.	Potash.	Water.
1. Albite	71·60	14·75	1·41	trace	1·06	10·06	·32	...
2. do	70·68	19·80	·11	...	·23	9·06	....	...
3. Sanidin	67·42	15·88	2·83	·15	2·77	·43	10·55	...
4. Microlin	66·9	17·8	·5	...	·6	6·5	8·3	...
5. Felsite	71·17	13·6	1·40	·1	·4	....	3·19	3·5
6. Pumice	70·00	16·00	·50	...	2·50	....	6·50	3·0

Professor Lawson has kindly handed me an analysis of "Rhombohedral Feldspar" occurring near Rome, by Jameson. This is apparently a Lepidomelan with most of the iron replaced by manganese and lime.

The following is a comparison of the two minerals:—

	Lepidomelane.	Rhombohedral Spar.
Silica	39·45	40·20
Alumina	9·27	9·00
Iron oxide	37·23	1·10
Manganese oxide	2·54	12·60
Lime	·31	20·80
Magnesia	3·29	....
Potash	5·06	12·00
Water	1·83	....

The analysis given by Dana, p. 238, of Gamsigradite, so named from the locality in Servia where it forms with white feldspar a rock termed timazite. It is an aluminous iron manganese amphibole, and contains:—

Silica	46·58
Alumina	13·63
Iron	12·29
Manganese oxide	6·00
Magnesia	8·84
Lime	8·83
Soda	3·17
Potash	1·00

I do not know that manganese presented in this form is of commercial value, but its occurrence in connection with the gold-bearing strata is interesting. If the rock under consideration is to be viewed as a volcanic slag, and as having carried up its manganese contents from some unknown sources, there must be large amounts of this element contained in some silicates, and their decomposition may often prove to be the source of the deposits of manganese ores found in later rocks.

Since writing the above, I have noticed a reference showing the practical relationship of rocks containing manganese to deposits of the ores of that metal of economic value. Mr. Halse, in a paper read recently before the North of England Institute, describes some of the Merionethshire (?) manganese deposits, in one of the hills north east of Arenig, consisting mainly of Upper Trappean rock, with a mass of feldspathic porphry. He states, from a careful examination of the veins, that there is no evidence of their being fissure veins, the manganese merely locally filling the joints and certain superficial fissures in the country rock. It appears that the manganese has come from the feldspathic ash itself, and as a result of surface decomposition and erosion has been leached out from it and deposited in the joints and fissures.

It is to be regretted that analyses of the country rock were not given. The mode of occurrence of the ore described by Mr. Halse is that usually affected by manganese, and a good example may be seen near the Salmon River of Truro.

The other sample is a compound containing zincite, red oxide of zinc; Franklinite, an iron black compound, iron, manganese and zinc, and Willemite, a whiteish silicious oxide of zinc.

This was found at Forrest Glen, on the line of the survey of the Stewiack and Lansdowne railway, by Mr. T. Ritchie, Civil Engineer. The samples were submitted to Mr. Fletcher of the Geological Survey. He expressed a doubt as to the specimen being from any local deposit on account of its strong resemblance to the New Jersey ore. Mr. Ritchie, however, assured me that he had made full enquiry, and was satisfied that the sample had not been introduced, but was actually discovered. I give the occurrence as of interest on account of the rarity of zinc ore in the Province of Nova Scotia. It is found in small quantities in the gold bearing quartz veins, as traces in manganiferous ores, and occasionally in the carbonate ores of the coal measures.

In New Jerssy, at both Franklin and Sterling, these three ores occur together, and in such quantity as to furnish an important ore of zinc. If, on further examination, the authenticity of the occurrence at Forest Glen is confirmed, and the float traced to its source, an important addition may be made to the list of our mineral resources.

CORRESPONDENCE.

Iron Mining in Ontario.

The Editor:

SIR,—Your timely article on this subject is very much to the point, but I hold that the duty of the Ontario Government goes even further than you indicated. What the iron industry lacks is a capitalist who can afford to risk a little in testing commercial processes. Mowat claims a surplus of over five millions; Hardy claims a partnership in form of royalty in all new developments; the whole province will benefit by substantial progress in its mines; so why should not the miner get the same consideration as all other classes of our population.

To place us on a par with farmers and professionals we ought to have a public smelter at each mining centre owned by government, controlled directly by the Bureau of Mines, and giving returns which would settle the commercial value of the ores submitted in quantity. The recipes for best methods could be obtained more cheaply and correctly through official than private channels; and once obtained, would be available for all the miners in Canada. Were private parties bonused to smelt, they would keep improved methods secret still, and every new enterprise would have to begin as if the Government had done nothing to aid us.

Then again, at a private smelter, there is always a doubt that results would be manipulated to enhance or decrease the value of the ore tested for speculative ends. But under the management of the present efficient Director of the Bureau of Mines, returns would command the confidence of the mining world and afford a far better field for the exercise of his talent and industry, than collecting "Arthur's Pence" from reluctant miners. A public assay for one dollar is another necessity which might easily be supplied. We have quite a number of private assayers at from $3 to $10, whom no one outside of Ontario knows anything, and whose assay is therefore of no commercial value. Similar assays in the United States cost less than half, on an average, and reach a hundredfold as many possible purchasers.

Set a standard, give certificates to all reaching that, with right to assay, charging balance of cost to Government as may be settled by Bureau. Also give discoverer the benefit in a reduction of first cost of land instead of a remission of royalty eight to fifteen years after he has had his pinch to secure the discovery. If prospectors are sometimes unreasonable, they are nearly always badly used in selling; and if they cease to discover where will all the rest of mining interests go?

HOMO SENEX SYLVARUM.

Sudbury, 15th July, 1893.

The Russell Silver Mine, Calumet Island, Que.

The Editor:

SIR,—A few days ago I paid a visit to the J. and C. Russell silver mine on Calumet Island, and with your kind permission I will give your readers a short sketch of the progress made, so far, in its working.

The mine is situated on lots 10 and 11 in the 4th Range of Calumet Island, about three and a-half miles from the Village of Bryson, the *chef lieu* of the County of Pontiac, and about 4 miles in a straight line from the nearest station on the P & P. J. R.—also about eight miles from Cobden on the C. P. R. Mr. James Russell, of Renfrew, Ont., originally bonded the property five years ago, and finally purchased it for $12,000, two years ago, having meantime prospected it so thoroughly as to leave no doubt about the deposit of ore being very extensive. The mineral is zinc blende—a combination of zinc, lead and silver. Numerous assays have shown from 40 to 54 per cent. of zinc (taking the lowest and highest assays), 10 to 14 per cent. of lead, carrying 12 to 16 ounces of silver to the ton. One main shaft and numerous lesser ones have been sunk at various points on the property, and in every one heavy leads of the mineral have been exposed, varying from a few inches to six feet in width. In the minor shafts or openings, which are quite shallow, the widest lead is about 30 inches. When work was commenced at the main shaft the mineral only showed about 6 inches in width, but now, at a depth of 30 feet it shows fully 6 feet wide and extends from a depth of about 15 feet to the bottom of the shaft. It seems to run in an eastward direction from the shaft, and inclines downward in the same direction. By the leads whose width I have given, I mean that width of pure mineral, bright, sparkling, soft, brittle, heavy, the most beautiful stone I have ever seen. Outside said leads there is a vast quantity of "lean ore"—rock impregnated with the mineral in varying proportion. Several hundred tons of ore have been taken from this main shaft, some of which has been piled in the vicinity, some shipped to different points for practical testing, and several magnificent samples were sent to the World's Fair at Chicago. At the time of my visit only the simplest and most primitive machinery was employed—a large bucket and windlass—but I have no doubt whatever that with the introduction of improved machinery and better facilities for handling the ore that this mine will become of immense value. The ore is there in vast quantity—anybody can see it—and as it can be handled with great profit, all the mine wants is more capital expended for machinery, and Mr. Russell has a bonanza. He richly deserves his good fortune, as he has ventured a large amount and—won.

H. T. HURDMAN, M.D.

Bryson, Que., 15th July, 1893.

The Kaslo District, British Columbia.

The Editor:

SIR,—At the present time—with only a very few exceptions—properties here have been bought (I refer to those that have been sold), by Americans.

I believe that somehow the outside public have got an idea that the Slocan mines are not proving to be as good as was expected. If so, such is probably due to the check in real estate at Kaslo, caused by the boom being pushed too hard and by rumors from the outside world, at a time of the year (the end of March), when all the properties in the camp were deep under snow; and those that were worked looked the better for it instead of worse. Perhaps another cause was the stoppage in shipping ore caused by the breaking up of the sleigh road, which became so bad that until lately even pack animals could not travel it. It has, however, been repaired as far as built last fall (16 miles), and construction advanced four miles further to Bear Lake, at which point the gang are at work with the intention of pushing on to New Denver, on Slocan Lake.

The money for the present work is being supplied by the Provincial Government, amounting to $10,000, whereas that expended last fall, about $20,000, was subscribed by the miners and citizens of Kaslo.

The mines, as you may easily imagine, are placed in an awkward position, owing to silver question and the great financial difficulties of the day. Yet nearly all of them in the Slocan are working. They are for the most part being developed; and where capital can afford it, it is surely the most expedient course, as transportation is extremely high, $35 to $45 a ton delivered at Kaslo. Then, too, the miners are confident of a great reduction in freightage, inasmuch as they feel confident of railroad communication.

Notwithstanding the terrible freight rates, which in the first ran as high as $100 per ton to the smelter, 1,000 tons have been shipped (entirely to the U. S. smelters). The returns show from 130 ozs. to 500 ozs. in silver per ton, and from 50 to 70% lead (ton of 2,000 lbs.) These figures stand for the galenas; the carbonates run high in silver but considerably less in lead. No concentrating works are yet in operation, or even under construction, at the mines, and consequently considerable good ore has to be left on the dump for future date—but it is a noticeable fact that much the greater part of our ore requires no concentration. Large bodies of it running as high as 80% lead. Perhaps one of the causes cited on the outside as the cause of alarm, is the fact that the "Freddie Lee" has stopped producing ore. What miner could condemn a mine which from the very grass roots yielded a ton of ore to every lineal foot of ground broken—dead work included—(and this shows what little dead work was done), for over three months. It was worked for ore only from the outstart. Such is the position of the "Freddie Lee" at the present time. It is now being worked with a view to the future and not the present.

But the "Freddie Lee" is not the only prospect the camp depends upon by any means. The "Washington" is looking better by every foot of ground broken. It did for a considerable time last spring (in spite of the fact that the intention of the owners was toward development), produce 10 to 15 tons per day of shipping ore.

It has been employing as many as 45 men, but at the present time 26.

The "Mountain Chief" is another property that has been pushed all winter and is looking all that could be expected; the ore centre has been constantly widening and the ore is of exceptionally high value even for this camp.

Other properties that have kept open during the winter are the "Dardanelles," the "Northern Belle," the "Lucky Jim," the "Chambers," the "Wellington," the "Blue Bird," and a few others.

These numbers are being added to every day as the snow goes off. One of the new properties, called the "Stanley," took out 100 tons of 130 oz. ore in 15 days after work commenced.

On the "Lucky Jim," or rather on the neighboring claim in the same group as the "Roadley," two new finds have been made which are remarkable in point of size.

It has been unfortunately a bad winter for snow here as elsewhere, and even yet a large number of the prospects are unable to commence development work; the snow laying pretty generally above an altitude of 5,000 feet at the present time.

A sampling works is at present under construction on Kaslo Bay, which shall have a capacity of 100 tons per diem. The road to the site has been finished, as well as one of the buildings and the wharf, and the other buildings are well under way. The machinery is not yet in but expected daily. This undoubtedly will be a great help to the miners, especially those with insufficient capital to carry ore until such time as a carload is obtained. And it will be the means of allowing prospectors to work to a greater or less extent their own claims.

There is no time better than the present, for those men who still have faith in silver, to make investments in mining properties here while the depression lasts.

The Ainsworth camp, which for a time this spring looked so promising, has entirely shut down, not one property being worked. The cause is entirely due to the market; everything looked its best up to the last moment.

Yours, &c.,

FRIEBERG.

Kaslo, B.C., 14th July, 1893.

CANADIAN COMPANIES.

The Van Winkle Hydraulic Mining Co.—A correspondent to the Vancouver *World* contributes the following anent the operations of this company. The property is situated two miles from Lytton, on the opposite side of the Fraser River, and just beyond the town of Lytton. The water is brought from Last Chance creek, a distance of two miles, by 1¾ miles of ditching and a quarter of a mile piping, the gore at the penstock being 36 inches in diameter and tapering from 12 feet to 18 inches; the balance of the pipe is 18, 16 and 15½ inches in diameter. The sand tank is 375 feet above the flume, near the river, where the monitor is placed. They were running 1,600 miner's inches of water, which they soon expected to have increased to 2,000 by making some repairs to the ditches. This done, they will then be able to run to better advantage. The present power is 50 lbs. to the square inch, and they were moving about 2 to 2½ cubic yards to the miner's inch of water per day. The nozzles of the monitor are five, six, seven and eight inches in diameter. The eight-inch one was being used. The deflector, which enables a man with one hand to turn the stream in any direction instantly, is Hoskin's patent, but not considered the best. To give some idea of the immense power of this water from the nozzle of the monitor, I may state that they can move with it boulders 500 lbs. in weight. When the water is turned on the gravelly banks, they are run down through the flume very quickly. The cut where they were washing was, as nearly as I could judge, about 80 feet deep, 100 feet wide and back about 300 feet, a smaller cut still further back, about 200 feet, washed out by turning water through it when not using the monitor. They were possibly 30 to 40 feet from bed rock. Eastward about 200 yards, another cut is started, where they have another flume for running waste water. It is the intention to run the pipe to this cut and station another monitor, then they both can be worked at once or alternately, allowing time for the very large boulders to be disposed of. Bed rock can be reached at this cut. The dump at each is good, and the flumes for catching the gold are supplied with all modern improvements. The property has nearly two miles frontage, and extends back about the same distance. Even with big water power all the time, it will last for generations. Over portions of this ground miners have made $10 a day to the man with a rocker, and in all their shafts they have good prospects. The first wash up will likely be made in June some time, although it all depends on circumstances. Miners everywhere will watch with interest the result of this clean up. Vast enterprises of this nature are now under way in Cariboo, and will likely be worked to some extent this year; but the expense up there for working is far greater ere they can get any returns. It is hydraulic mining that will undoubtedly give an impetus to gold mining in British Columbia.

The Hall Mines, Limited, British Columbia.—Advices from England under recent date report the floatation of an English syndicate to acquire and work the celebrated Silver King and associated claims at Nelson, in the West Kootenay district, Province of British Columbia. The capital is £300,000 sterling, divided in 50,000 7 per cent. cumulative shares of £1 each, and 25,000 ordinary shares of £1 each. The board of directors include: Sir Jos. W. Trutch, K.C.M.G., chairman; James Roberts Brown, Esq., London; J. R. Drake, Esq., Sydenham; Rankine Dawson, Esq., M.A., M.D., London; Robert Day, Esq., High Sheriff of Cork; D. H. Gribb, Esq., Isle of Bute; Walter Neilson, Esq., Eisenfield, Ayr; Secretary, F. Ramsay, Esq. The head offices of the new syndicate are at 111 Wool Exchange, London, E.C. Mr. Roepell, the mining engineer who examined the property on behalf of the English investors, in the last paragraph of his report says: "I have to state that I consider the mines of the Kootenay Bonanza Mining Co. a most valuable property, the value of which consists not only in what is already known, but also in its remarkable prospects for the future. I feel confident that if properly taken in hand and managed, it will rank among the greatest and most profitable enterprises of the kind." It is stated on the authority of the manager of the Bank of British Columbia at Victoria, that the owners of the Silver King receive £200,000 in paid up stock and an amount equivalent to the expenditure made by them to date in the development of the property.

The Provincial Manganese Mining Company, Limited, has been organized at Windsor, N.S., to develop property containing some 300 acres of manganese lands near Walton. The capital is $75,000. The officers of the new concern are: D. C. Fraser, M.P., president; George E. Boak, vice-president; W. F. Jennison, Lewis W. Des Barres, and J. P. Burgess, secretary-treasurer.

Byron N. White Company has been incorporated under the Foreign Companies' Act, B.C., with a capital of $500,000, to develop mineral claims in the Sloean and other mining districts of the province. Head office is at Nelson, B.C.

The Thompson River Hydraulic Mining Company, Limited, has been incorporated under the laws of British Columbia to purchase and develop certain placer mining claims on the Thompson River and its tributaries, British Columbia. Authorised capital $100,000 in shares of $10. Head office, New Westminster, B.C. The directors are: John Hendry, J. W. Vaughan and Robert Jardine, all of New Westminster, B.C.

The Fuller Mining Company has been incorporated in Spokane, Wash, with a capital stock of $100,000, with shares at a par value of $1 each. The trustees are T. D. Fuller, of Ruby, Wash.; A. J. Duncan, G. H. Herberling, W. H. Wiscombe, W. H. Downes, G. E. Spoor, S. A. Wells and J. W. Feighan, of Spokane. The company owns the Fuller group of mines in the Okanogan country, B.C. The principal place of business is Spokane, Wash.

General Phosphate Corporation—a Secret Meeting.—In pursuance of the direction of Mr. Justice Vaughan Williams, a meeting of the shareholders of the General Phosphate Corporation, Limited, was held on 16th ulto., at the Cannon street Hotel, "for the purpose of ascertaining their wishes as to whether an order shall be made on a petition to wind up the corporation, presented by George Mander Allender, that the above named corporation shall be wound up compulsorily." Lord Stalbridge presided. At the outset a shareholder rose and asked whether the representatives of the press were present, because, if they were he wished to know whether it was advisable that matters which were likely to be discussed on that occasion should be made public. ("Yes," and "Certainly.") The chairman replied that in his opinion, as they had met to consider what he hoped would prove to be the reconstruction of the company, and what was a purely private matter, and to deal with private documents which were headed "private and confidential," it would be advisable to ask the gentlemen of the press to withdraw. Mr. Barham strongly objected to any such proposition, it was most unusual—in fact, he never heard of such a thing before. This was a public meeting of shareholders, and there should be no privacy of any kind. (Hear, hear.) Mr. Judd also protested against the proposal, which he characterised as monstrous. Mr. Clough said that as a member of the committee he would ask the meeting to so far repose confidence in the judgment and discretion of that body as to accept the suggestion that the representatives of the press should withdraw, as the committee had their own reporter present and a verbatim report of the proceedings would be taken. In view of what the chairman had said and what was in the minds of the committee, he thought it advisable that the reporters should withdraw. (Hear, hear.) He moved a resolution to that effect. Mr. Smallman said he thought that anybody having read the report of the committee could not for a moment imagine that it should be discussed in any other place than a public assembly. There were such grave statements made there against——. The chairman said he must ask Mr. Smallman not to go into the report. Mr. Smallman remarked that what he wished to say was that there were statements made in that report as to the truth or otherwise of which he thought the chairman and his colleagues ought to be first to welcome a public inquiry. The chairman again requested Mr. Smallman to deal only with the point before the meeting. It was not right to go into matters at the present moment which were private and confidential. Mr. Smallman: But I understand we have come here to discuss the report. The question was then put to the meeting, and the chairman declared that the majority was against the reporters remaining; he therefore asked those gentlemen to withdraw. Mr. Smallman demanded a poll, but the solicitor said the question was not one upon which a poll could be taken. The reporters of the press then withdrew.

Referring to the above, which appeared in the London *Financial Times* of 17th June, Mr. George Stewart, of Buckingham, Que. (one of the vendors), now in London, England, writes: "There was a large attendance of shareholders present at the meeting, and they were unanimous that the company should not be wound up. It was agreed to formulate a scheme to raise the necessary capital as indicated in the committee's report, viz., £100,000, and a resolution to this effect was passed and the meeting adjourned for a month. Anything approaching "stormy" was noticeably absent. Everybody seems to think it best under the circumstances to give the business another trial, and your humble servant was heartily in accord with them."

Bridge River Gold Mining Company, Limited, is the name of a new company seeking charter of incorporation under British Columbia statutes. Authorised capital $25,000, in shares of $100. Directors: George E. Bower, John Leatherdale, Wm. G. Allen, Joseph A. Russell and F. R. M. Russels, of Vancouver, B.C. Formed to carry on the business of smelters, refiners, founders, assayers, dealers in bullion, metals and products of smelting of every nature and description, to carry on the business of miners, &c. Head office: Vancouver, B.C.

Tobique Gypsum Company—Is an applicant for charter of incorporation under the New Brunswick Joint Stock Companies Act. The capital stock shall amount to $200,000, consisting of $150,000 of 'A' stock, being ordinary stock of the company divided into 1,500 shares of $100 each, and $50,000 of 'B' stock, divided into 500 shares of $100 each, being preference stock, having preference and priority as respects dividends, at the rate of six percentum per annum thereon, and in the distribution of assets, with the provision that the holders of such preference shares shall have the right to select two directors if the board consist of five directors, and three directors if the board consist of seven directors. The amount of capital stock actually subscribed is $104,000, being $18,000 of preferred and $86,000 of common or ordinary stock. The head office is to be in the Parish of Gordon, County of Victoria, New Brunswick. The directors are: Fred. H. Hall, Woodstock, N.B.; John Connor, St, John; James Stratton, St. John, N.B.

The New Brunswick Coal Company—A meeting of shareholders will be held in the office of Stephens & Mitchell, in St. Stephen, N.B., on 2nd August, for the purpose of establishing by-laws, choosing directors, etc.

New Egerton Gold Mining Company—The New Egerton Gold Mining Co., composed of New Glasgow, N.S. gentlemen, purchased in 1877 a number of mining areas in the Fifteen-mile stream gold mining district. A 10 stamp crushing mill had been erected previous to the purchase. This company operated the mine until December 31, 1889. During that time they mined 4,871 tons of quartz, from which they obtained 2,320 oz. of gold, value $44,086. They then sold out to another company of New Glasgow men, who styled themselves the New Egerton Company. These men put in a new 15 stamp mill, and new hoisting and pumping gear. For the year 1890 they mined and crushed 2,476 tons of 2,000 lbs. quartz, which yielded 2,184 oz. gold; in 1891, 4,263 tons quartz yield 2,446 oz. gold; and for 1892, 2,460 tons quartz, which yielded 1,285 oz. gold. Total for those three years 9,199 tons quartz, gold 5,915 oz, value $112,373. For the total period worked by the Egerton and New Egerton companies the number of tons quartz raised was 14,070, and the yield of gold 8,235 oz.; value $156,470. The profits were something in excess of $40,000.

Last winter an amalgamation was completed with the Stanley Gold Company, owning adjoining property, and work was resumed in May, after stopping through the winter, the management being in the hands of the New Egerton Company The mine is now free from water, and mining and crushing has begun on a limited scale. The mine is equipped with two crushing mills—one, the Stanley, being driven by water—good hoisting gear, pumping apparatus, air compressor, and air drills and such other machinery as is necessary for free milling ore. The mines are in the Fifteen-Mile Stream district, Halifax County, Nova Scotia.

Kingston and Pembroke Mining Company—The annual meeting of this company was held in Kingston, May 23rd, when the following directors were elected: H. Seibert, J. D. Flower, J. H. Hollister, New York; W. G. Pollock, Cleveland, Ohio; M. H. Folger, B. W. Folger, F. A. Folger, J. Bawden and C. F. Gildersleeve, Kingston.

Sudbury Nickel Mine Company—At the annual meeting in Berlin, Ont., recently the old board of directors were re-elected as follows: J. G. Reiner, Wellesley, president; Jas. Livingstone, Baden, vice-president; C. H. Ahrens, Berlin, secretary-treasurer; F. Walter, Hamburg; C. Kritzinger, Heidleburg; Dr. W. Morton, Wellesley; F. B. Puddicomb, Haysville; Geo. Fleishaur, Tavistock; J. D. Moore, M.P.P., Galt. A motion was carried authorizing the board of directors to make arrangements to work the mine to the best interests of the stockholders.

The Gold River Gold Mining Company, Ltd.—Is the latest Nova Scotia mineral enterprise seeking incorporation under provincial statutes, with the object of acquiring and working gold areas in the County of Lunenburg or elsewhere in Nova Scotia. Authorised capital, $50,000, in shares of $1. The directors of the new concern are: Milner T. Foster, Halifax; Jas. P. Burgess, Halifax; A. N. Whitman, Halifax; George Musgrave, Halifax; and Ingram B. Shaffner, Halifax. Head office: Halifax, N.S.

MINING NOTES.

[From our own Correspondents.]

Nova Scotia.

A writer in the *Colliery Guardian* of recent date says: "It has always been a matter of surprise to me that the briquette has never penetrated the taste of the Canadian consumer. A very extensive and useful plant was erected some years ago at the Gowrie Mines, Cow Bay, but the effort was abortive; the briquette did not sell. The market of Montreal is scarcely the market for the briquette. This is a fuel for the remoter markets of Canada--that is to say, for the rural districts. Wood is annually falling off as a fuel in these districts, and from patient research I am satisfied that an effort to introduce the briquette would be well repaid. At present the slack coal is sold at a dollar a ton, but in briquette shape very much more could be obtained. Another very important reason of the failure of the briquette in Canada is the excessive percentage of pitch introduced into its composition. The peculiar stoves and chimneys of Canada cannot be adapted to such pitch depositing fuel. The new system, however, noticed in your columns lately—*i. e.*, that of compressed coal, reduced to brick shape under enormous pressure—removes this drawback and opens out a field for effort as yet absolutely unexploited."

Mr. James Baird, Manager of the mines of the Canada Coal and Railway Co., has resigned.

Messrs. Matheson & Co., of New Glasgow, had on the stocks at our recent visit to New Glasgow, a large steel steamer called the Mulgrave. She is 122 feet long, 34 feet wide and 16 feet deep. Her engines are compound condensing, having cylinders 22 and 42 inch by 30 inches stroke, and indicate about 600 h. p. The launch of the new vessel has since been successfully accomplished. The Nova Scotia Steel and Forge Co. of New Glrsgow furnished the material. The new venture it is hoped marks a new era in the industrial progress of Pictou County.

New Brunswick.

Mining in a small way has been resumed on the Grand Lake coal areas in the vicinity of the Newcastle river. At this point there is a vein of coal varying from 20 to 36 in. in thickness and from 20 to 40 ft. below the surface. At several points drifts have been run into the side of the hill and the coal mined without any attempt at scientific working. About 6,000 tons were taken out in this way last year, and it has now been decided to work the vein more systematically. The owners have put in engines with hoisting machinery and pumps, and have commenced to sink a shaft upon the veins.

Quebec.

Ottawa County.

Mr. J. Burley Smith, M.E., Glen Almond, Manager of the British Phosphate Company is to be congratulated on the following high assay returns of a recent shipment from his mines to England. The analyses were made in duplicate and with the greatest care by Mr. J. T. Donald, M.A., the well known phosphate analyst of Montreal, who writes that it is the richest parcel he ever analysed. The following is a copy of the certificate:—

Laboratory No. 338.

Of a sample of Phosphate marked No. 1, received from British Phosphate Co. Ltd., 8th June, 1893.

*Phosphoric Acid = 40·23%

Ferric Oxide } = 1·75%
Alumina }

*Equivalent Tribasic Phosphate Lime = 87·83%

Ontario.

A letter from Superintendent Wallace of the Ophir Gold Mining Company, under date of 22nd inst., gives the following particulars of the progress of mining on this well known property:—

"Our friends cannot realize, nor do they believe what they see or hear of the wonderful ore bodies being uncovered. I took the measurements yesterday for the President of the Company, and copy from my report the following statement, which I will try and explain more fully after giving the figures. The pay streak at the following points measures:—

At the lower opening near the incline	4	feet.
At the second opening at the entrance of drift.	10	"
At bust or head of drift 70 feet in	22½	"
At open cut above this 100 feet.....	16	"
At the end of tunnel, upper drift	17½	"

Average of 5 drifts and openings, 14 feet.

"This does not include the incline, which is in rich ore to a depth of 105 feet, and one shaft 95 feet deep also in ore, which I reported in a former letter.

"The depth of lowest point on the incline from upper level is 215 feet, length of vein exposed from incline to last drift on the vein is 475 feet. On the basis of one ton to each nine square feet, which is high enough to cover any fault in the vein, we have 181,555 tons of ore in sight on the pay streak alone; besides this there is 20 feet of quartz that will mill $12 per ton that I did not take into consideration. Our mill returns have netted over $60 per ton to date on the ore from the pay streak; cut this down to $20 and we have in sight $3,631,100. I have 7,000 tons of ore on the dumps that will pay for the mine and all development work, as well as the mill and machinery. These figures I do not give for publication but as facts that you can realize something of this property. The mine is so favorably situated that I can easily cut 40 tons per day with 10 men, and in view of this I am simply doing development work to prove up the property, until the mill is completed and I can make new dumping ground for the ore mined.

"I have from the first had great faith in this mine, but as depth and length is reached, exposing the vein, one's mind is confused by what he sees and undertakes to estimate on substantial facts. It is only nine months since I commenced development here, and at that time very little was known of the property and less believed. Now I have visitors from every part of the globe, and all admit that the mine is a wonder, and to have you fully realize that I am expressing the general and universal belief, I hope you will take time to convince yourself of its truth by coming to see the property.

"The mill is being pushed as fast as possible to completion, the machinery is all at Bruce Station, and delayed there on account of the roads, which the government was to repair in part, and the company (Ophir) has expended large sums in doing. I am now repairing the bridges in order to get over them with heavy machinery. As soon as this is done we shall begin to put the mill together, and by September 1st expect to get started milling ore."

The combined output of the Copper Cliff and Evans mines at Sudbury amounts to nearly 300 tons a day, and both smelters are kept going full blast the whole time. It is said that there is not a pound of matte to be had at any of the mines just now.

An important new find is reported on the Black Jack gold mine, Lake of the Woods district. Two shafts are being sunk on the property, both of which will be equipped at once with hoisting machinery. It is reported that the Crawford mills at the Black Jack are a failure.

A disastrous fire on 1st ultimo destroyed the mill at the El Divir gold mine in the same district.

An American company has acquired the Reduction Works at Rat Portage, and will, it is said, re-equip them with machinery.

North-West Territories.

A despatch from Edmonton says that during his recent visit to the North-West, Dr. Selwyn, Director of the Canadian Geological Survey, visited the Egg Lake country at a point about 27 miles north-west of Edmonton to examine a reported petroleum find there. He is fully satisfied that the find is genuine, but is not satisfied as to its extent. The petroleum sand rock found there is identical with that found on the Athabasca, and may be an extension of the beds existing there, or it may be merely a mass detached from the tar sands of the Athabasca and transported to its present location by glacial action ages ago. The lie of the country gives no indication in support of either theory, and there are no rock exposure to assist in deciding the point. The only way to decide the matter is by actual boring. Dr. Selwyn is desirous of seeing this commenced as soon as possible. If this deposit should turn out to be an extension of the tar beds of the Athabasca, it could hardly fail to be of the very greatest economic value. The indications here are just such as are found in petroleum producing regions the world over. But even these indications are not infallible proof of the existence of oil in paying quantities. That question can only be settled by actual test.

British Columbia.

Miscellaneous.

The East Wellington Coal Co. having ordered a reduction of 20% in the wages of all their employees earning in excess of $2 per day; the men have gone on strike, and about 150 miners are thrown out of work in consequence.

The annual general meeting of the employees of the New Vancouver Coal Company, to consider the report of the medical committee, was fixed for 22nd instant. The report will show that there is a balance in hand of $464.15. The total receipts for the year amounted to $15,613.25, the expenses amounted to $15,138.10, the principal items of expenditure being surgeon's salary, $8,216; and special grants to J. Williams, $800; W. J. Pollard, $500; and like amounts to the following: S. Kenyon, J. Spooner, W. Arbuckle, J. A. Macaloney, W. Richardson and S. Woodburn. Relief was granted for 59 accidents, distributed as follows: No. 1 Shaft, 29; Protection Island, 4; Southfield, 6; No. 3 Shaft, 4; No. 5 Shaft, 13; outsiders, 3. The top men employed at the colliery have decided to manage their own accident fund, but will maintain the present arrangements as to the employment of the doctor.

Advices under date of 5th inst. report that the North Star (silver lead) mine has changed hands at $40,000. The property is situated in the St. Mary's country, about 14 miles from Fort Steele. The average yield reported is 50 ounces in silver and 45 per cent. lead. Twenty men are employed here.

It is understood that arrangements have been made with the owners of the North Star mine by the Golden Mining and Smelting Company, whereby the latter will acquire five thousand tons of the North Star ore. The ore will be reduced to a matte and then shipped to England for treatment, very favorable rates having been made by the C. P. R. for the shipment.

The East Kootenay Hydraulic Company has its hydraulic plant in operation on Wild Horse creek, and it is the intention to run night and day during the season. The grounds are lighted at night by electricity, and the power is supplied by a Pelton water motor. The company employs twenty white men and no Chinese.

Tom Brown, a fourth year student in McGill University, Montreal, who is taking a course in mining engineering, will not loose a chance for practical study during the long summer vacation. Dressed in corduroys and top boots, he shouldered a pack at Nelson on Friday morning and started for the Hall Creek placer diggings, where he has located a claim, and intends building a shack beside his "Clementine," the name under which he has recorded his claim.

At the Thunder Hill mine great activity prevails. Some 45 men are engaged and 100 tons of ore are being mined daily. It is expected that the shipment of the concentrates will be made in the course of a week or two.

Another despatch says: The concentrator of the Thunder Hill mine, on the shore of Upper Columbia Lake, in East Kootenay, is in operation, and the first shipment of concentrates was expected at Golden this week.

Work has been commenced in earnest on the Poorman, situated about six miles west of Nelson and about a mile from Kootenay River. This property is owned by the Eagle Creek Gold Mining Company, and has not been worked to any extent since the fall of 1890. The ten stamp mill which the company built at the mine was completed early in the spring of the above year, and started to crush ore about June 1st. There are at present ten men at work in the mine taking out ore besides those engaged in operating the mill. Work will be pushed and the mill run day and night in order to take advantage of the high water.

The shaft on the LeRoi is down 190 feet. This will be sunk 20 feet deeper, when a drift will be started both ways at the 200 foot level. The shaft is in solid ore the whole 200 feet.

Gold ore assaying $400 to the ton has been taken from the LeRoi mine, Trail creek, at a depth of 174 feet, and the ore body from which the assay sample was taken appears to be of the same grade. Mr. Pugh, manager of the Pyritic Smelting Co., is bringing in a dimond drill, which, with other machinery for the LeRoi, War Eagle and California, is now awaiting shipment at Spokane until the wagon road is completed from the river to the mines.

Slocan Country

[From the Spokane Mining Review]

The Slocan country is rapidly assuming great activity. Before this month is out the wagon road will be completed and in good condition to Bear Lake, and regular shipments of ore will again be made from the properties where it has been accumulating, as well as from properties that have not yet made any shipments. Notwithstanding the fact that the road has been impassable for teams and hazardous for pack horses for more than two months, the owners of many of the properties have never suspended work, but have taken provisions and powder in as best they could and continued to develop and pile up the ore.

Anyone who has not been in the camp since last fall would be surprised to find the amount of work done since then, and the results have in every case been highly satisfactory. At no time since the discovery of mineral in that camp has everything looked so favorable. The snow is rapidly disappearing and prospectors are pushing into the hills in the hope of making new discoveries. Messrs. Wm. Springer, Thomas McLeod and A. S. Beebe, made a valuable discovery at the lower end of Slocan lake, where they found and made a location on a vein two and a half feet wide, carrying from $900 to $1,000 per ton of silver in milling ore.

Frank Hughes expects to ship a carload of ore from the Mountain Chief, soon, which will exceed anything yet shipped, the owner claiming that it will net him $40,000.

A carload of ore will be shipped from the Big Bertha, on which the owners expect to realize from $10,000 to $20,000.

h Washington never looked better; the recent strike of ore on the third level is the best yet made, and places a greater ore value in sight.

The Reed & Robinson group, bonded by Messrs. Chadbourne & Co., is looking well, with a large body of high grade ore exposed.

The Grady group, on Four-mile creek, is a remarkably fine property and Messrs. Biggs, Latz and Grady hold it at a firm price. The group consists of four properties. At one point there is an ore exposure of seven and a half feet, which crops out solidly and has been stripped for a distance of from twelve to fourteen feet. The vein crops for a distance of 3,000 feet, showing solid ore from two inches to three feet wide at the outcrop. There are 1,000 tons of ore in sight and on the dumps. The owners have done all their own work.

The Idaho, which is under bond by Ed. Gove and others, is in full operation again, and it is the intention to continue uninterruptedly all summer, increasing the force as fast as possible. There are 200 tons of ore on the dumps, which runs from $100 to $1,000 per ton. The character of the ore is steel galena, gray, copper and silver glance. The ore will average more than $150 per ton. The ledge is well defined; is four and a half feet wide, and shows two feet of fine steel galena ore at the end of the upper tunnel, which is now in the hill forty-five feet.

The Cumberland, which is just below the Idaho on a parallel vein, has been operated all winter and has a 130 foot tunnel. At the depth of 100 feet a fine body of steel galena twelve to sixteen inches wide was encountered in the vein, which is four feet wide, and has continued since, being rather larger at the face of the tunnel than at any other point. One hundred and twenty dollars is the lowest assay so far made on the ore. A small force of men are working night and day, and 100 tons of ore are on the dump. The property is located in Idaho basin, on Carpenter creek, and is at an elevation of 5,000 feet above Kootenai lake.

The Almo has a 130 foot shaft on ore all the way down. At the bottom of the shaft there are thirty inches of gray copper and steel galena ore. A large quantity of fine shipping ore is now on the dump, which will be shipped at an early date and other shipments will follow rapidly.

The Lucky Jim is one and a quarter miles from Watsonville, on Bear lake. It was bonded by E. C. Kilbourne, of Seattle, and Mr. Roadly, of Kalso. A body of solid galena ore was struck a few days ago on this property, which is four and a half feet wide. The ledge is eight or nine feet wide. Two carloads of ore will soon be shipped from this property.

Both the routes from this city to Kaslo are open now, and little difficulty is experienced in making the trip.

The activity of both the Kaslo-Slocan and the Canadian Pacific Railroad people is significant of early railway facilities, and although the towns are generally quiet, as they are elsewhere, there is certain to be a marked improvement before the season is over.

[From the Nelson Tribune]

A recent discovery on a branch of the north fork of Carpenter creek, is in rank with the best ever made in Slocan district The ore is gray copper, and assays gave a return of 1,252 ounces silver, 22 per cent. lead, and 7 per cent. copper, to the ton. The discovery is distant about four miles over the range to the north of Watson.

Work has been resumed on the No. 1 and Highland mines, at Ainsworth. A large body of high grade ore being struck in the former. Alex. McLeod has been given a contract for hauling the ore from the mine to the ore warehouse at Ainsworth. He brings down from three to four tons daily with one four-horse team.

During five days of last week 167 sacks of ore were taken from the tunnel in the Idaho mine in Slocan district. Since then work has been suspended, owing to the low price of silver. Work has also been suspended on the Freddy Lee and Young Dominion, for the same reason. The Idaho is the mine that shipped twenty tons of ore to the Tacoma smelter, the net profits on which were $64 a ton. The ore went $119 in silver and $49 in lead—a total of $168. The transportation and smelting charges were $83 a ton, the duty on lead $21 and the cost of mining $10—a total of $104.

Ore is being shipped to Kaslo from the Wellington, a Slocan mine, the property of an Ottawa company, of which Edward Watts is manager.

Safety Net at the Blanzy Colliery France.*

It happens too frequently that men fall down mine shafts owing to carelessness or a faulty movement of the cage. The accident generally proves fatal; but this is not always the case, and it might be possible to save some lives if it were not for the danger of drowning in the sump. The chance of life, therefore, depends upon the speed of rescue; but, unfortunately, none of the means generally adopted are really practical to permit of rescuing those who have the misfortune to fall down a shaft. A regulation was issued some years ago by the Prefect of Saone-et-Loire enjoining the erection, at all the mines in the Department, of vertical iron ladders, fitted to the side of the shaft and reaching from the lowest landing to the deepest level of water in the sump. These means of safety, however, become illusonary on acccount of the time occupied and the danger of descending; and the lowest landing may occur at a considerable height above the bottom, owing to exploration works. It is thus that the Blanzy Colliery has in its shafts sumps 120 m. and 150 m. deep, while one of them, that of the Saint-Louis shaft, is even 325 m. (176 fathoms) deep; and, as it was evident that the company could not erect ladders of this depth, their length was officially limited to 25 m. The danger, therefore, remained equally great as before for depths lower than 25 m.

At the request of the Government engineers for the district, the Blanzy Company's engineers devised for the Jules Chagot shaft, the sump of which is 120 m. (65 fathoms) deep, an arrangement for preventing falls, or, at any rate, catching the bodies of those who should be so unfortunate as to fall down the shaft. The essential portion consists of a wire-cord net fixed 2 m. below the stops of the lowest landing, which is 320 m. deep. The net has square meshes of 10 cm. (4 in.) wide, being made of cords composed of galvanized steel wire, with resistance to tensile strain of 150 kilogs per square metre (95¼ tons per square inch). The cords are made up, some of twenty and others of eighteen wires, a difference which has since been found unnecessary. The form of the meshes is preserved, so far as practicable, by a special method of construction. The net is surrounded by a frame composed of wire rope 27 mm. (over 1 in.) in diameter, forming a nearly square figure of 2.6 m. by 2.7 m. (8 ft. 6 in. by 8 ft. 10 in.)

The net is hung by sliding bolts to the timbers of the shaft, placed immediately below the landing frame, by means of loops formed by bending the rope which forms the frame (the loops enclosing iron rings to keep them distended), the total length of the net from centre to centre of these rings being 3.3 m. (20 ft. 10 in.), and its weight only 130 kilogs.; but subsequent nets have been slightly increased in length, and consequently in weight. Each loop is held by its bolt, which passes through a double socket made in a piece of angle iron fitted to the timbers, in such a manner that, on withdrawing the bolts on one side, that side of the net falls.

It is easy to lower and replace the net in case it is necessary to go down the sump, one side being let down by small ropes so as to hang vertically out of the way of the tubs. To replace the net, the side hanging down is drawn up again by the small ropes, and the loops secured by the bolts, the letting down and taking up being the work of two men and ten minutes. The nets cost 500 to 600 fr. (£20 to £24), whilst their fitting up and placing in the shaft amounted to about the same sum.

The net has often proved of great service in accidents to plant. On one occasion, when the cage came down on the stops at too great a speed, the shock deranged the mechanism for working them. As a length of slack cable was unrolled, the cage fell a distance of about 2 m. (say a fathom) into the net, which withstood the shock. The damage was slight and easily repaired; and perhaps, without the net, the winding rope might have broken. On another occasion, a damaged truck was being brought up attached to the bottom of the cage, because it could not be got inside. The rising cage was about 70 m. from the surface, when the truck fell and cut the coupling bars of the descending cage, which also fell the 70 m. into the net. The empty cage and the truck together weighed 3 tons, the impact of which, falling 70 m. (to say nothing of the additional 200 m. that the truck fell) was sustained by the net, which resisted the shock. Although the net itself was damaged, none of the ropes composing it were broken, and only one fastening. It was necessary to replace the net; but the cage could be used again after a few slight repairs, whereas, if it had fallen into the sump, its value would only have been that of old iron. The saving thus effected, added to that of the time which would otherwise have inevitably ensued, largely compensate for the cost of renewing the net. On another occasion a tub full of gob fell from the pit mouth, the full height of 330 m. (180 fathoms) into the net, which sustained no serious damage, while it also held the tub.

M. Lebreton concludes that these three accidents, in which the net stood violent shocks, prove the efficacy of the measure, while the working of the net has proved no obstacle to winding. It closes the shaft sufficiently without preventing the air-current from reaching the preparatory works below. The success achieved decided the Blanzy Company to apply the net to all their winding shafts with deep sumps.

* From a communication by M. Lebreton to the *Annales des Mines.*

The Choice of Coarse and Fine Crushing Machinery and Progresses of Ore Treatment.

By A. G. Charleton. *

Part I.—Introduction.

The title of this paper has been suggested to the writer by a most interesting contribution on the subject of gold-quartz reduction, read by Mr. A. H. Curtis, at a recent meeting of the Institution of Civil Engineers, which the writer in common with other visitors, had the pleasure of hearing discussed at the two following sessions.

The subject is of such wide scope, that the writer ventures to think some of the points Mr. Curtis dealt with may be enlarged upon, and in fact the subject can be approached from several different points of view (notably from a metallurgical one) without exhausting it, or in any way attempting to trench on matters which Mr. Curtis has more particularly disposed of.

In summing up, Mr. Curtis arrives at certain general conclusions, which are almost entirely in accordance with the writer's own experience, viz:

I.—That the most suitable machine for preliminary coarse-crushing of nearly all ores (depending on individual circumstances, referred to later on) come under one of the two following classes:—

A. Those with a reciprocating-jaw action, either hung at the top on a rocker shaft, so as to swing freely backwards and forwards at the bottom (on the well known Blake and Marsden principles), or pivoted at the lower end, so as to move to the greatest extent at the top (like the Dodge).

B. Those with a gyratory movement (like the Gates or Comet crusher).

II.—That for medium-coarse (below 2½ inches) to fine-crushing, necessary for an ore which has to be amalgamated, concentrated, lixiviated, chlorinated, or treated by any of the various modifications of these processes which have sprung up of late years (each with some special claims of its own), the types in their own particular provinces, of the best classes of machinery to employ, are represented by:—

C. Gravitation stamps.

D. First-motion rolls for medium and fine work; or geared-rolls for coarser ore sizes, and

E. Centrifugal roller-mills (such as the Huntington) which have stood the test of wide use, and time.

If, however, it is intended to reduce to pulp ore already crushed fine, as required in certain branches of amalgamation, one must add to this list:—

F. Edge-roller-mills of the improved Chilian type, Frankfort mills; and what are known in America as

G. Combination-pans, a modified form of the old Wheeler-pan.

Coarse-Crushing.

Although hand-spalling with a sledge still holds its own for breaking gold-quartz in a number of Queensland mills and other places where stereotyped prejudice still holds its position, mechanical means should generally be used for breaking the ore (as it comes from the mine) to a convenient size for its subsequent treatment. The exceptions to this rule are: If the stone contains mineral, which can be picked out at once and shipped to smelting-works to be otherwise dealt with; if manual labour be exceptionally efficient and cheap; if power of any sort be exceptionally dear; if the location of the mine * render the transport and operation of heavy machinery practically out of the question; or if the location of an existing mill of old construction will not allow of the introduction of an ore-breaker with its accompanying bins, grizzleys and automatic-feeders, etc. In point of fact the first is the only case in which spalling can compete with rock-breakers in a modern mill properly located and arranged,† as for instance, where a concentrating ore carries some such combination as argentiferous galena and zinc blende, mixed with carbonate of lead, and copper pyrites or iron pyrites, spathic iron and quartz. The result of crushing ore like this, would be to break up much of the blende, pyrites, etc., into grains, which, with specific gravity ranging only from 3·9 to 5·1, could not be thoroughly seperated from one another by jigging, or any other mechanical dressing process. A mixture of these minerals‡ has no market, and hence crushing without some previous selection would obviously result in loss.

The ore for example at Ems which is divided into (1) rich galena ore; (2) cobbing ore; (3) pyritiferous cobbing ore; and (4) barren rock furnishes an illustration given by Kunhardt.§

In many localities, however, as he remarks, loss or no loss, the value of labour is too high to admit of spalling and cobbing being carried out together (as they have to be in such cases) and at best it is a painfully primitive practice, which, carried out on a large scale, retards, or

* From the paper read before the Federated Institution of Mining Engineers.

* Since the introduction of sectionalized machinery and the application of electricity to long-distance transmission, remoteness from civilization influences this aspect of the question, more than local engineering obstacles.

† Assuming it to have a capacity of 20 tons a day, or anything over that amount.

‡ Above certain proportions small enough to be neglected.

§ *School of Mines Quarterly*, series 2. "The Art of Ore Dressing in Europe.

even prevents, by the sedentary nature of the work, a healthy physical development of the youth of the mining population, though on the other hand, it certainly tends to stimulate their faculties of observation.

In class A, the best known crushers are the Blake and Blake-Marsden stone-breakers.

The Blake-Marsden hand-hammer-action crusher takes, it is claimed, less power to get through a given amount of work than the Blake ; nevertheless it does not appear to have come into such general favour for mining purposes. Perhaps this may be accounted for by its greater prime cost, weight, and the large space it occupies, for it seems a simple and well-built machine.

The chief disadvantages, which attach to the use of the above class of ore-breakers are :—

(*a*) That the moving jaw only does effective work during the forward stroke, rendering the action an intermittent one.

(*b*) That thin, flat pieces of rock may at times pass the jaws without being broken, an objection, it may be remarked, which is not of very great consequence to the miner, unless the product of the machine is unusually large, and goes direct to automatic feeders.

(*c*) That the stone leaving the machine is of continually varying sizes.

With regard to the Dodge, its special advantages are :

(*a*) Its light weight.

(*b*) The jaw being fixed at the bottom (1) the size of the product can be more easily regulated ; (2) is more uniform in size ; and (3) the stones can be crushed down finer than with crushers of the preceding class.

The Dodge is more particularly recommended on these grounds, for fine-crushing in concentration-works, although its capacity is more or less limited as compared with the Blake, owing to the fact that it gives a finer product.

It should also meet a want in small mills, which cannot keep a more powerful breaker fully employed, or as a preparatory machine for finer crushing, in Rolls or a Huntington.

Belonging to class B there are :—

1. *The Gates or Comet Rock and Ore-breaker.*—Owing to the gyratory movement of the breaking-head of this machine on an eccentric, within a circular outer shell, which is protected with toothed liners, and is shaped like an inverted cone, it is claimed :—

(*a*) That flat pieces of rock cannot pass through it uncrushed to the same extent, as in a machine with reciprocating-jaws.

(*b*) That as the area of breaking-surface increases towards the discharge end, the material as it is broken smaller is spread over a larger space, which results in finer crushing than is practicable with a reciprocating jaw-machine.

(*c*) That as the head is loose on the eccentric spindle, there is no grinding action, and there is a line of crushing-surface from top to bottom of the head and liners in constant action.

(*d*) The area of breaking surface is about three times as great as in reciprocating machines of similar power. This seems to admit of the machine doing nearly treble the work in any given time, driven at the same speed, and of tipping into it large quantities of stone (using a hopper); dispensing with much of the attention necessary with machines belonging to class A.

(*e*) That, having a comparatively small crushing-surface acting continuously, dispensing with a fly wheel to store up power (apart of which is wasted), and the rock which is to be broken being supported at its ends only, in the circular crushing-chamber, less power is required, as compared with a jaw machine, to do a given amount of work.

Quoting the report of a committee, on a competitive trial between a 9 inches by 15 inches Blake-Marsden, and a 9 inches by 14 inches Gates, at Meriden, Connecticut, on May 30th, 1883, the makers of the Gates assert that, crushing the same kind of stone to an equal size, the latter machine crushed over three times as much in a given time, and showed a saving of about 33 per cent. of the indicated power consumed in doing the work.

On the other side, it must be said, that a Gates of an equal capacity will not take in a lump of rock of as large sectional dimensions as a Blake or Marsden ; and the latter machines have the advantage in respect of weight and prime cost ; the price of the large sizes is in fact extremely heavy, and the height of the Gates is also a disadvantage, where fall has to be economized. The injury done to the machine, which might result from a hammer head, or drill falling into it (a not unfrequent occurrence through carelessness, or occasionally other reasons) has also to be considered, and there is no doubt that the Gates requires particular attention, in keeping it properly lubricated with suitable lard, or heavy lubricating oil. The head and liners are made of especially chilled, cast white-iron.

There is one particular case, however, which should be pointed out, in which the Gates seems to possess very special advantages over other crushers and that is, where there is a wide lode yielding large quantites of milling ore, in which the stone breaks "large" in stoping it down, and requires in consequence to be spalled, to get it into the jaws of an ordinary breaker. Under such circumstances, a Gates may obviously serve a very useful purpose indeed, as the larger sizes will take in whole lumps, as big as can be handled, and by this means the tedious and expensive process of breaking in the mine, or "breaker-floor," is avoided.

The measure of economy in using a large sized breaker of the kind will necessarily depend, however, on being able to keep it fully employed, as well as possessing ample storage-bin room and driving power. As an instance of the work it can accomplish under such circumstances, the Caledonia mill in Dakota may be quoted,* where one No. 6 Gates, with receiving-openings 12 inches by 18 inches, attended by one man, crushed 200 tons in 10 hours, and did the work formerly set for three No. 5 Blakes (the largest ordinary pattern in the market), with a receiving-opening 9 inches by 15 inches. These latter took five men 20 hours, it is said, to produce the same result, requiring the same amount of power. It is asserted by the makers of the Gates, that its action entails less stress on the structure it is mounted upon, than is the case with a reciprocating breaker, but one is somewhat inclined to doubt whether this holds good in starting it when empty, whatever may be the case whilsts it is running full.

Its size, and weight, must evidently be special objections, when it has to be mounted on a lofty structure (like the back floor of a stamp mill); and where the stone is divided, along a long line of bins, the advantage of using one large machine, is more or less offset by the difficulty of distributing the ore between them, unless there is an exceptionally large fall to spare. Under such circumstances the only practical escape from the difficulty, is to set the breaker apart from the mill (if possible close to the shaft); and it is not improbable that this is, as a rule, (where the mine and mill are owned by the same company, and the former keeps the latter entirely occupied), the best disposition to adopt. This does away with much of the dust which plays havoc with the bearings of the other machinery of the mill, permits of lighter framing for foundations and superstructure, less grading (in some cases), † and a smaller annexe to the main building.

2.—*The Lowry Ore-breaker.*—A second form of gyratory crusher has quite recently been introduced by the National Machinery Co., of Tiffin, Ohio.

A description of this crusher appeared in the *New York Mining Journal* of December 5th, 1891.

Its construction is illustrated by a diagram, which shows it in section, with a removable revolving top for fine-crushing, containing two or more holes, to regulate and spread the stone round the breaker-head. The ore is thrown into a hopper, and is discharged as fast as it is broken, avoiding any danger of clogging. The Lowry ore-breaker appears to occupy the same position with regard to the Gates, that the Dodge does to the Blake, as the vertical shaft is fulcrumed below the crusher-head instead of above it ; consequently there is less motion, so it is asserted, at the bottom of the jaw, and the product is said to be more even than that of any of the jaw-crushers, in which the jaw is pivoted at the top, a statement which is no doubt correct.

The chilled-iron head or cone appears smaller in the Lowry breaker than in the Gates. The chilled-iron ring or liner, which forms the outer crushing-face is cast in one solid piece, having a solid turned bearing and supporting-backing behind it. The machine is adjusted for crushing to various sizes by screws at the side of the crushing mortar, by which the liner can be raised or lowered. This is done to obviate the necessity of lifting the vertical shaft, carrying the crusher-head, the bottom of which always remains in the oil chamber of the eccentric, at the base of the machine. The vertical shaft is driven by ropes with sufficient laps around the pulleys, and with provision for adjustment in the tension-pulley.

As one of the chief advantages of this machine, the manufacturers claim that the crusher-head strikes downward, and has a tendency to draw in the material to be crushed, which would not be the case if the vertical shaft were fulcrumed at the top.

These breakers are made in nine sizes, having a capacity varying between 5 and 250 tons per hour.

Without having seen both machines at work and knowing more about the Lowry, it is impossible to institute a fair comparison between it and the Gates. But it is probable that, comparing the former with reciprocating-jaw machines, most of the arguments for and against the Gates seem to apply equally to its new competitor.

The purpose for which an ore-breaker is intended, its capacity, saving in space occupied, weight, quickness in setting to work, ease of repair, simplicity of construction, wear per ton of ore, liability to serious or minor accidents, first cost, and consumption of labour in attendance, lubricants, and power required per ton of ore crushed, will all influence the choice of a machine, and no hard-and-fast line can be drawn, between the various coarse-crushers which have been mentioned, each possessing a sphere of usefulness of its own. In fact, as some of the above conditions are to a certain extent conflicting, a careful consideration of the particular circumstances of each case is absolutely necessary. In judging of the relative economy of different crushers in regard to consumption of power, it is perfectly correct that the only true test of their efficiency is the actual, indicated, useful effect shown per lb. of fuel burnt in cubing a certain class of stone to a given size. This method of comparison is, not however, so entirely reliable as would at first sight appear, unless the machines under trial be driven with the same engines and boilers, by the same enginemen.

The consumption of fuel will, in fact, differ in different works, according to its quality or description, the size and type of engine and boiler employed, and the care bestowed in looking after them.

* "Gold-milling in the Black Hills," by H. O. Hofman. *Trans. Am. Inst. Min. E.*, vol. xvii., page 498

† When rock-breakers and ore-bins are used with automatic-feeders at the back of a stamp-battery, which has tables and concentrators below it, the least practicable fall that ensures the automatic movement of the ore through the various stages of the process is about 33 feet from the rock-breaker to the concentrator floor.

Further than this, it is absolutely necessary to compare the exact time the crushing lasted, deducting all stoppages since an engine which is idle, during the time the boiler fire is alight, may be consuming—in proportion to the useful work done—much more fuel than either the indicated or real horse power (measured while the engine was working) would lead one to suppose. The different sizes, weights, capacities, size to which the stone is cubed, size and speed of driving pulleys, nominal horse power expended, and cost of the Blake, Blake-Marsden, Dodge, Gates and Lowry ore crushers, are given in the subjoined tables, as far as it is possible to ascertain them :

DIMENSIONS, PRICES AND PRODUCT OF THE BLAKE STONE AND ORE BREAKER.*

No.†	Size of Receiving Opening.	Approximate Product per Hour in Tons crushed to 2 inch size.	Weight of Heaviest Piece.	Total Weight	Extreme Dimensions.			Driving Pulley.		Proper Speed.	H.P. Required.	Price F. O. B. Chicago.
					Length.	Breadth.	Height.	Diam.	Face.	Revs. per Min.		
	Inches.		Lbs.	Lbs.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.			£ s. d.
..	3 × 1½	Laboratory.	40	100	1 1	0 6	0 10	0 5	0 1	300	.	10 8 4
A	10 × 4	4	1,993	4,719	4 6	4 0	3 11	1 8	0 6	..	4	62 10 0
2	10 × 7	6⅔	3,950	7,896	5 4	4 6	4 5	2 0	0 7½	275	7	104 3 4
5	15 × 9	10⅔	7,179	15,749	6 8	5 0	5 3	2 6	0 9	..	10	156 5 0
8	20 × 10	13⅓	7,700	17,000	6 10	5 9	5 11	3 0	1 0	250	14	218 15 0

† There are various intermediate sizes not mentioned in this table ; the 20 inches by 15 inches, with a product of 20 tons per hour, being the largest.

* Messrs. Fraser and Chalmers' *Catalogue No. 4* (Gold and Silver Mills), and Egleston's *Silver*, page 358.

Size A—Takes pieces 4 inches thick, and crushes to ½ inch or less. 2—Takes pieces 7 inches thick, and crushes to ¾ inch or less. 3 and 4 are used for road ballast, furnaces and breaking smaller for other crushers. Mr. H. S. Munroe* places the cost of repairs for eight 7 inches by 15 inches lever-pattern crushers (Blakes) with corrugated jaws, estimated to have crushed 224,203 tons of limestone, at Bonne Terre, Missouri, in 12 months, at :—

	£	s.	d.
12 levers, at $25	62	10	0
9 jaw plates, at $15	29	1	3
12 jaw plates, at $12	30	0	0
Toggles, check-plates and sundries	51	12	6
Total cost	£173	3	9

This represents an average of about £20 16s. 8d. for each crusher, breaking 80 tons per diem, to 1½ inches, but does not include the cost of babbitting bearings, or labour in making repairs.

From these data, the average life of the wearing parts of a jaw-crusher, appears (similarly circumstanced) to be about 8 months.

The lower box of the pitman shaft must be packed with thin wood packing, to prevent the key tightening the box to the shaft. Iron plugs should be kept in the oil holes, and if the fixed jaw requires to be cast up, it should be backed with zinc plate about ¼ inch thick.

The amount of product depends on the distance the jaws are set apart, the speed, and also on the nature of the ore.

The product given in the table assumes the jaw set 1½ inches open at the bottom, the machine run at proper speed, and properly fed, but it will vary somewhat with the character of the stone, brittle stone, for instance, going through faster than sandstone.

The No. 2 Blake is made in sections for mountain transport. Total weight, 6,881 lbs. ; cost, £145 16s. 8d. No piece of this machine weighs over 332 lbs.

* "The new Dressing Works of the St. Joseph Lead Company. *Trans. Am. Inst. Min E.*, vol. xvii., page 659.

DIMENSIONS, PRICES AND PRODUCT OF THE DODGE CRUSHER.†

No.	Size of Jaw Opening.	Approximate Product per Hour to Nut Size.	Total Weight.	Driving Pulley. Diameter.	Width of Belt used.	Proper Speed. Revolutions per Minute.	H. P. Required.	Price F.O.B. Chicago, Complete.
	Inches.	Tons.	Lbs.	Inches.	Inches.			£ s. d.
1	4 × 6	½—1	1,200	20	4	275	2— 4	52 1 8
2	7 × 9	1—3	4,300	24	5	235	4— 8	93 15 0
3	8 × 12	2—5	5,600	30	6	220	8—12	114 11 8
4	10 × 16	5—8	12,000	36	8	200	12—18	187 10 0

† Messrs. Fraser and Chalmers' *Catalogue No. 4.*

The power required per ton will, of course, vary with the size to which the stone is broken, requiring additional power to break it smaller than ordinary macadam.

An elevator and screen are used when it is desired to break everything down to ⅜ inch.

If the product is not required smaller than ¾ inch, and some "spalls" are not objectionable, the screen and elevator are not needed.

Prices of Gates' breakers with revolving screen and return elevator fitted complete, on frame, size 0, with 24 inches by 36 inches revolving sereen, £156; size 1, with 24 inches by 36 inches revolving screen, £208; size 2, with 24 inches by 36 inches revolving screen, £250; size 3, with 24 inches by 36 inches revolving sereen, £354.

Elevators 24 feet between centres, including connections, range in price for the various size breakers (from 1 to 7), from £56 to £127, and weigh from 2,000 to 5,000 lbs. Revolving screens, with dust jackets, cost from £42 to £146 (exclusive of connections) and weigh 2,000 to 8,000 lbs.

Medium Coarse and Fine Crushing.

From the point of view of the mechanical engineer the superiority of one machine of class II. over another, for the reduction of a certain kind of stone say granite), can in a measure, be pretty easily demonstrated, but the question as a miner requires to look at it, becomes one of extreme complexity, as the factors to be dealt with are variable and conflicting, in more ways than one.

Viewed in this light, if the field of selection be limited, merely to the three classes of crushers particularized on page 233, the choice of the best for any special case appears to depend on three equally important considerations, which are altogether outside the primary question of the mechanical merits or demerits of a particular machine, and it is here that the experience of the mining engineer is called into play.

To arrive at a trustworthy solution of the problem, he must take into consideration: 1st, the character of the ore itself and its associated gangue; 2nd, the degree of comminution to which it is desirable to carry reduction in order to get the best results out of any particular system of treatment that may be adopted; whilst in some cases the location of the mine and the nature and position of the mill site, also form a third factor of the question.

To put the matter in a nut shell and go a step farther, it may be laid down as a rule, that setting aside any other machines which have claims to attention, where one of the three classes of crushers (stamps, rolls, and roller mills) now under consideration is found, commercially speaking, to best meet the needs of the miner in any one instance, it is most unlikely that either of the other two types, will be found suited to the requirements of the same case; if indeed, they did not turn out on trial absolute failures, supposing one kind of machine to be substituted for another.

An ideal "reduction plant," would have to establish a claim to extract the largest percentage possible of gold or other metal automatically in the shortest possible time, and in the simplest possible manner, combining capacity for expeditiously reducing the greatest quantity of ore in a given time to any desired point of fineness, with a minimum production of fines or slimes; it should further possess strength and durability without being cumbersome, and have as few working parts and auxiliary appliances connected with it as possible. Now, while this acme of mechanical and metallurgical perfection combined has yet to be invented, the success of one type of crusher as against another in various instances, may be directly traced to the fact that some of those features which are wanting in one class of machine, are found more or less developed in one or other of its competitors. In selecting the most suitable machinery for his own particular object it is therefore incumbent on the miner not to lose sight of the points that have been indicated, as they may relatively affect in a different degree the circumstances he happens to have to deal with.

The adaptability of the plant in the foregoing respects, however, is not everything, as the outlay it may involve must after all be justified by the returns it will yield. He has therefore to compare:—

1. The prime cost and weight of each class of machinery, with its indispensable adjuncts for extracting the commercially valuable metals from any particular ore, representing a very variable capital outlay to produce a given result.

2. The simplicity or complexity of the entire plant in each case, not only with regard to cost of repairs, but also the time lost in maintaining it in running order in out-of-the-way places, difficult of communication, and where skilled labour is perhaps not available.

3. The relative time required to erect each different class of machinery; and lastly,

4. The comparative costs (both in regard to quantity and price) of labour, fuel, oil, etc., required to run a given class of plant in a certain locality.

Under these circumstances, with the limited data possessed at present in the shape of independent figures throwing light on many of these questions of relative efficiency and cost, at most only general statements can be made; and any attempt to assert the adaptability or superiority of one machine or class of machines for all cases, must infallibly break down.

Each form of crushing machinery has its champions and detractors who freely express themselves for or against it, according to the measure of success it happens to have achieved merely in their own limited personal experience; and where failure occurs, the machine not unfrequently is blamed, when in some instances it is owing to want of forethought on the part of the purchaser in overlooking natural contingent results, which might have been reasonably foreseen and easily escaped.

The degree of comminution to which it is desirable to carry reduction to get the best results out of any particular system of treatment rests on the general nature of the process employed to extract whatever of value the ore contains; this is dependent to a very large extent on the ore itself and its associated gangue.

The choice of medium and fine-crushing machinery must then be regulated, from a mechanical standpoint, as well as by the class of ore it is required to crush, bearing in mind that ruinous losses may ensue by going to either extreme. That is to say, in selecting a machine, if crushing is carried to an unnecessary degree of fineness, money is wasted in doing unnecessary work, which shows itself in the cost sheet at the end of the year, besides risking various mechanical and metallurgical losses.

Amongst these latter, may be enumerated, slimes and fine mineral in suspension, in concentration, and wet amalgamation; dust in furnace and other dry processes; and various inconveniences in filtering and extraction, in those cases where ore has to be lixiviated; all entailing extra expense, to mitigate a difficulty which has been artificially created.

If, on the other hand, the crushing is not fine enough, a proper percentage of the metals (remaining as they do locked up in their stony envelopes) is not secured. So that whether water be employed to concentrate them, mercury to entrap them, chlorine to attack them, or some chemical solution to extract them, there is a more or less considerable loss, which ought to be carefully studied, for the purpose of finding the vanishing point (so far as it can be learnt) common to all these combined sources of trouble.

One may say then, that there is a certain average degree of fineness, to which it pays best to carry reduction in every process (varying with the ore, and the method of treatment). But before this point can be settled it is

Dimensions, Prices, and Product of the Blake-Marsden (with Lever and Eccentric Motion), Stone Breakers.*

Size of Receiving Opening.	Approximate Product per Hour to Road Metal Size, 2½ Inches.	Total Weight of Machine.	Extreme Dimensions. Length.	Breadth.	Height.	Driving Pulley. Diam.	Face.	Proper Speed. Revolutions per Minute.	H. P. Required.	Price.
Inches.	Tons. Cwts.	Lbs.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.			£
12 × 8	5 8	10,080	8 1	3 7	4 9½	2 0	0 5	250 to 300 revolutions.	5	113
15 × 8	6 5	12,880	8 9½	4 10	5 3	2 6	0 6		7	135
15 × 10	7 10	15,680	8 9½	4 10	5 3	2 6	0 7		8	150
18 × 9	8 15	17,584	8 11	4 11	5 0½	3 0	0 7		9	165
20 × 10	10 0	22,400	9 11	5 5	5 4½	3 0	0 7		10	180
24 × 13	15 0	30,240	10 6½	5 8½	6 7½	3 0	0 9		12	263
24 × 16	16 0	31,360	10 6½	5 8½	6 7½	3 0	0 9		14	275
24 × 17	16 5	31,920	10 6½	5 8½	6 7½	3 0	0 9		14	282
30 × 18	20 6	33,600	....	....	....	....	....		18	375
34 × 18	23 2	42,560	....	....	....	....	....		20	413

* Makers' catalogue and correspondence.

The makers state that it is advisable to use an engine of 2 horse power more than stated in the table, as it is more economical to run a larger engine, than to run one up to its full power (this remark also applies to the Blake and the Gates crushers). The principal working parts are all crucible steel.

Dimensions, Prices, and Product of the Gates or Comet Ore Crusher.

Size.	Dimensions of the Three Receiving Openings combined.	Dimensions of each Receiving Opening, about.	Weight of Breaker.	Capacity per Hour in Tons of 2,000 Lbs. passing 2½ inches Ring according to Character of Ore.	Dimensions of Driving Pulley. Diam.	Face.	Space occupied by Breaker set up. Height from Bottom Frame to Top of Hopper.	Width of Frame.	Length of Frame.	Diameter of Hopper.	Revolutions of Pulley.	H. P. of Engine recommended to drive Breaker, Elevator, and Screen. Lime-stone.	Granite.	Net Price F. O. B. London.
	Inches.	Inches.	Lbs.		In.	In.	In.	In.	In.	In.				£
00	2 x 12	2 x 4	500	(Laboratory and sampling)	8	2⅜	24	17	26	13	700	½	½	25
0	4 x 30	4 x 10	3,100	2— 4	16	6	48	30	73	28	500	4	4	85
1	5 x 36	5 x 12	5,500	4— 8	20	7	54	31	76	37½	475	8	8	125
2	6 x 42	6 x 14	7,800	6— 12	24	8	60	39	90	39½	450	12	15	165
3	7 x 45	7 x 15	13,500	10— 20	28	10	73	48	103	44½	425	20	30	250
4	8 x 54	8 x 18	20,000	15— 30	32	12	85	54	114	51	400	30	40	400
5	10 x 60	10 x 20	27,000	25— 40	36	14	96	63	123	59	375	40	50	500
6	11 x 72	11 x 24	36,000	30— 60	40	16	109	73	139	66	350	50	60	725
7½	13 x 90	13 x 30	60,000	40— 75	48	18	116	73	144	120	350	60	75	1,040
8	18 x 135	18 x 45	89,000	100—150	48	20	156	90	164	132	350	125	150	1,450

necessary to decide what is the best process for the purpose in view, *i.e.*, in getting the largest commercial return on a given capital outlay.

On these grounds, it is of paramount importance that the chemical and physical peculiarities of the ore and its associated gangue should be first studied, and carefully noted in connexion with the local surroundings of the works, in regard to the character and cost of labour, fuel, supplies, and abundance or absence of water-supply, as well as climate and other considerations, which must influence the choice.

To enter into minute details concerning the peculiarities of various ores, and the processes of treatment they might be subjected to, is far beyond the scope of this paper, but from a general standpoint, as effecting the present question, the materials (ore and country rock and gangue) which the miner, the metallurgist, and mechanic, have alike to deal with, may be divided according to their physical characteristics, in three chief classes :—

(*a*) Brittle and hard ; such as quartz, most pyritic ores, syenite, and coarsely crystalline metamorphic rocks.

(*b*) Tough ; such as native copper, gneiss, and most of the micro and cryto-crystalline metamorphic and intrusive volcanic rocks, which accompany ore-deposits.

(*c*) Soft or clayey ; these latter comprising earthy carbonates, surface ores, or claycy limestones, as well as some classes of stone, comparatively hard and brittle like schist but carrying clay-partings, and sandstone.

When the different physical pecularities which attach to the first elementary mineral substance in the above list are considered, it is seen what wide room there may be for enquiry in this direction alone.

Silica which possesses no doubt a special interest to many engineers when it takes the form of gold-quartz, may possess under certain circumstances, what miners term a kindly appearance, tinged sometimes a light-gray, blue, or brownish-red colour, combined with a dark resinous look ; whilst elsewhere it may have a vitreous, wet, or opaque-white, hungry appearance, probably so-called by "cousin Jack," because it generally leaves him (if he attempts to work it) precisely in that very condition.

Still some of the best specimen-quartz is frequently milky, and white as a hound's tooth, whilst what is known as ribbon-quartz, a laminated variety of stone (separated by thin talc or chlorite-partings, or laminæ of graphitic shale or slate) is not unfrequently when met with, a good weight-carrier of metal. All these physical differences, due to peculiarities of hydration, association, and structure, will influence the way in which the stone breaks, and therefore affect its after treatment.

The materials dealt with by the mining engineer may, therefore, be divided according to their mineralogical characteristics and metallurgical behaviour, into a further number of classes, with different subdivisions :—

(*a*) Ores of the base metals, whether containing gold or silver or not, which have to be smelted or treated hy a wet process, either with or without a previous (hand or mechanical) coarse or fine concentration, matting, or roasting, depending on circumstances which need not be enumerated.

(*b*) Ores of one or both of the precious metals, properly so-called, comprising :

1. Free-milling gold ores.
2. Free-milling silver ores.
3. Pyritic ores of gold and silver.
4. Combinations of 1, 2 and 3.
5. Exceptional ores.

These different kinds of ore may be subjected to various processes, amongst the most general of which, for dealing with free-milling * low-grade gold ores (belonging to class 1) are :—

1. Stamping the ore wet to fine size, and catching the free gold on copper plates (inside and outside the battery), with wells and mercury traps, used as accessories.

2. Wet stamping the ore coarse, and amalgamating on copper plates, separating the coarse-sands from the finer slimes, by screens or sizing boxes (in some cases, preceding or following this separation by fine concentration) ; and regrinding the coarser sands thus saved, in Huntington or Chilian mills, or pans ; † followed by more copper plates.

For dealing with free-milling comparatively high-grade ores of gold, belonging to class 1, in which there is an excessive loss, if the previously described systems of treatment are followed (owing to the fine state of division of the metal, its alloyage with silver, or some other reason) there may be employed :—

1. Wet stamping, succeeded by direct pan-amalagamation on the ordinary plan (or else what is known as the Ross continuous system); or crushing dry (followed in exceptional cases by roasting) and then amalgamating in Chilian mills or pans. When there is a small percentage of rich sulphides present (espccially if dealing with a mixed gold and silver ore) fine *i.e.*, table concentration, may precede or follow the pan-treatment with an appreciable saving.

2. In a few special cases, like the Mount Morgan mine, Queensland, ores of this class may no doubt be treated in bulk with advantage by drying, crushing with rolls, partially roasting, and working by chlorination, in barrels. That the Mount Morgan ore may equally well be classed amongst the exceptional ores (belonging to class 5), becomes evident however, when the facts of the case are closely studied.

(*To be Continued.*)

* A term implying that the greater part of the gold is free.

† Without mercury preparatory to re-amalgamation.

The Silver King—A Sketch of the Discovery of Kootenay's Famous Mine.

In another place our columns contain particulars of the floatation of an English syndicate to acquire and work the Silver King mine.

The history of the discovery of the property now known as the Hall Mines, Limited, is a rather peculiar one. In the summer of 1886 Wm. Hall, Osner Hall, Wm. White, and several others were prospecting for gold placer on the head waters of the Salmon river and some of the smaller tributary streams. The party arrived near the summit, between Salmon river and Cottonwood creek, when a quarrel arose, which divided the outfit into two parties. One of these returned south by way of Beaver creek, and the other, consisting of the Hall brothers and White, kept on to the north. A day or two later some of the pack animals strayed away on the mountain side, and during the search for them the original Silver King lead was discovered.

The next season a location was made and a small amount of work done. This was followed for several seasons with varying success, but as the development progressed it became more and more apparent that the fortunate find would in time prove an unusually valuable property. Several disputes arose between the original owners, and a number of tempting offers for the purchase of the property were refused, owing to the lack of agreement on the part of the owners.

For over a year negotiations have been pending in England for the formation of a company with sufficient capital to handle the mine and its products properly. These have at last proved successful, and the Silver King group will, it is to be hoped, soon take its place as one of the largest and richest producers in the country. The Silver King lies between five and six miles south of Nelson, on the east side of Toad Mountain.

The showing on the surface is fully thirty feet without walls, and at a depth of 150 feet the ore body consists of sixteen feet of solid high grade ore and some twenty feet of a good class of concentrating ore. The expert who examined the property for the present company's incorporators, reported that in the 900 feet of the mine now opened up, there are 55,000 tons of ore practically "in sight," which on careful assays will yield an average of 100 ounces of silver per ton and 17½ per cent. of copper, or a value of $104 per ton. This would give something like $5,000,000 as the gross value of the property from what is now in sight. This ore, he reports, would give, after the erection of a smelter in Nelson, a profit of some thirty per cent. per annum for seven years on the capital stock of the company.

The ore of the Silver King is a combination of variegated copper pyrites and letrapedrite or gray copper. This latter is very rich in silver. Shipments amounting to 180 tons sent to different smelters have given an average smelting return of 213 ounces of silver and 18·17 per cent. of copper per ton, representing a value of $200 per ton. The ore also carries from $2 to $4 per ton in gold.

Soft Ore Mining.*

Soft ore being a relative term, it is necessary to explain that in this paper reference will be had to the brown hematites and limonities of the Marquette range, locally called "hematites" to the ores occurring east of the Menominee river on the Menominee range, to all the Gogebic and Mesabi ores and the Ely group on the Vermillion range. The ores occuring west of the Menominee river on the Menominee range may be as soft to drill as some of the ores just mentioned, but they are tough and strong and can be mined by methods prevailing in the hard ore regions.

The methods of mining made use of in the Lake Superior soft ore mines are as follows : 1 stripping and open pit work ; 2. rooming and timbering ; 3. filling ; 4. caving.

Stripping and Open Pit Work.—Open pit mining has been used more or less on all the Lake Superior ranges. The stripping has been done by pick and shovel or by scrapers, and the ore has been hoisted by derricks or over skip-roads built on the slope of the banks. As, however, the ore deposits on all the older ranges dip at angles over 45°, almost without exception, the limit of the open pit mining has soon been reached in each case. The discovery of the flat deposits of iron ore near the surface on the Mesabi range has lately revived the interest in this method of mining, and it will undoubtedly be used here on a much larger scale than on the older ranges. Steam shovels and locomotives are already pressed into service for removing the earth from above the ore beds, and though the strippers have suffered a temporary set back, owing to the difficulties of operating the steam shovels in the frozen banks during the last severe winter, they will eventually prove that the "stripping proposition" is both feasible and economical in the end. The question has been raised as to the amount of surface that can be economically removed, and in this respect I would state, as a basis for discussion, that where the volume of ore to be uncovered is equal to the volume of surface to be removed, it will pay to strip.

* Paper read by Superintendent P. Larson, of the Aragon Mine, Norway, Mich., at the meeting of the Lake Superior Mining Institute held at Iron Mountain, Mich., March 22.

Rooming with Timbering.—The system of rooming with timbering has been more extensively used than any other in our soft ore mines. The general plan under this system is to mine out certain blocks of an ore body on a given level in advance of others that are left temporarily for the purpose of supporting the rock walls. The relative size of these rooms and pillars varies greatly, but it is quite common to make the rooms from 20 to 24 feet wide and the pillars somewhat less. The length of rooms and pillars is equal to the width of the ore body. The rooms are worked from bottom to top of each lift, and heavy structures of timber are built up in the rooms as the mining proceeds upwards. In some of the larger mines, where this system has been employed, these huge underground structures have collapsed under the pressure from the surrounding walls, and in such cases the rooming system has either been abandoned or materially modified. Such extensive caves have, of course, temporarily checked the output of ore, and the system itself has sometimes fallen into disrepute. But in cases where the size of the ore deposit is limited, it affords a possibility of a forced output, a fact that commends it to mine owners. The great cost of the heavy timbering that it requires is, of course, one of the greatest objections to it. This cost rarely falls below 25 cents per ton of ore.

The Filling System.—Rock filling is often used in connection with rooming in which lighter timber can be used or entirely dispensed with. Where it is absolutely necessary to keep the surface above a body of soft ore from settling, as for instance in swamp or under a townsite or under a main line railroad, no other system than this combination of rooming and filling will answer the stated purpose as well. But such cases are not very frequent. The instances in ordinary mining practice, where rock filling is most economical and advantageous are those where the filling material can be put into the desired place without the use of shovel or, in other words, where it is not required to put in the filling close up to the back of a stope. Such a case occurs in the Chapin mine, where on the lower levels the ore is of sufficient firmness to hold up without the use of timber in 20 foot rooms carried across the whole width of the ore formation. Here the stopes are taken 9 feet high, and the rock filling is dumped by small cars within 4 feet of the back after the completion of each stope.

Other cases where rock filling is used are those where narrow deposits of ore can be mined longitudinally with stopes reaching from foot to hanging wall. In such cases the rock filling is kept pretty close after the miners, unless the hanging wall is firmer than we usually find it in soft ore mines.

The system of filling introduced 8 years ago into the Chapin mine, whereby the whole ore body in each lift was mined by slicing the ore out floor after floor from bottom up, and by filling each slice close to the back with rock, has been abandoned on account of the great expense of shoveling, filling into the stopes and the high cost of the necessary openings.

Caving.—Two distinctly different applications of the caving method are now used on Lake Superior. In the one the miners commence stoping at the top of a lift and are always working under a "gob" roof, while in the other they attack the ore at the bottom of a lift and work under a crumbling block of ore, which keeps sinking down to them. The former method has long been employed in European soft ore mines, especially in the north of England, and it has been in use for a number of years in this region, while the latter is a new method, adopted on a large scale 1½ years ago in the Chapin mine. The former is well adapted to such soft ground, where the ore can be mined chiefly by pick and shovel, while the latter can be used in quite firm ground, which breaks up more or less in settling, before it reaches the miners, the bottom floor alone being in its natural solid state when mined. The north of England system has the advantage that it can be used in irregular bodies without danger of leaving off-shoots from the main ore body. Where it is desired to use the Chapin system in relatively flat or irregular ore bodies, it becomes necessary to make the lifts short. In such cases it may be found advantageous to use a modification of the north of England system, such as is now successfully employed in the Chandler mine, where each lift is mined from top down but each floor is taken 15 feet thick. Other applications of the caving system may be seen in the Norrie and Lake Angeline mines, where on the chamber-and-pillar plan the ore is mined in vertical sections from the hanging to the footwall, and the hanging wall rock or the overlaying "gob" is caused to run into these sections as they proceed towards the foot.

In conclusion it may be said that the conditions that meet the miner in the different mines are so varied, that no two mines can be marked by exactly the same plan. Such of us as have had pet methods are fast giving them up. Those that have advocated filling may occasionally find it to their interest to cave, and those that are professional cavers are sometimes found to be engaged in rooming, and we would perhaps all be only too glad to join our Mesabi friends in adopting their "stripping proposition," if nature had not turned our ore deposits edgewise in the ground. We must, however, adapt ourselves to the conditions that meet us, and, by learning from each other's experience, endeavor to keep ourselves to the front among American miners.

Murday's firedamp detector (Journal of the Iron and Steel Institute, 1892, No. 1, p. 380), as adapted for colliery use, has been brought out recently, and is illustrated in the technical journals (Colliery Guardian, vol. lxiv, p. 789 ; Electrical Review, vol. xx, p. 517.

Steel Trucks in Belgian Collieries.—In the Belgian collieries, trucks made entirely of metal have been in use for several years. Drawings of these trucks, published by P. Vanhassel, show that repairs are cheaply and easily affected. A damaged part has merely to be unrivited and replaced by a fresh one kept in stock. The damaged part is, as a rule, merely bent, and being of steel, can be staightened and used again. A truck of this type can be put together without difficulty by a lad, the separate parts having been purchased. A truck with a weight of 375 lbs. and a capacity of 336 lbs. of coal costs 26s. In many Belgium mines, the wheels of the truck are loose and turn freely on the axle, the advantage they present being the small resistence they offer in passing round curves. The wrought-iron axles are square in section with 1.38 inch side. Four wheels and two axles weigh 132 lbs., and cost 19s. 9d. The entire truck weighs 507 lbs. and cost £3, 5s. 9d. The weight of the truck is, to that of the coal carried, as 1 is to 2·3, and this may be considered a very favorable ratio. A truck of the old type with wooden body weighed 551 lbs., and cost £3, 8s. By the introduction of trucks with steel bodies the output of the Mariemont mine has been increased 40 per cent.

Incline Truck Drop for Calcining Kilns.—A new incline truck drop for use in connection with calcining kilns is described by Mr. C. Wood, in a paper read before the Cleveland Institution of Engineers. This drop was designed for lowering the trucks from the top of the kilns at the Tees iron works, where the space was very limited, and for that reason a drop of the ordinary design was not admissable. After a description of the form of drop usually employed in the district, the details of the latter design are given. Four columns support girders, on which is mounted a shaft with four rope pulleys and a rake-sheave. The counter-balance weights work inside the two main columns. These stand on one side of the centre line of the kilns, from which the truck is run on to the lowering table, its weight being so placed as to keep the guide-wheels in position. The table at the bottom of its travel is tilted automatically, and the stops withdtawn so as to discharge the trucks on the same side as that on which they were received.

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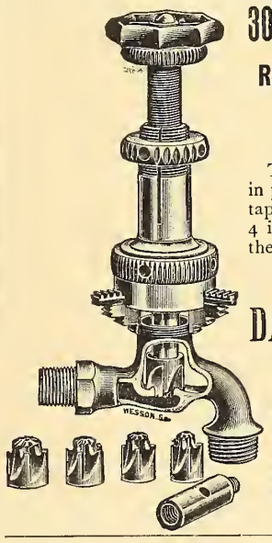

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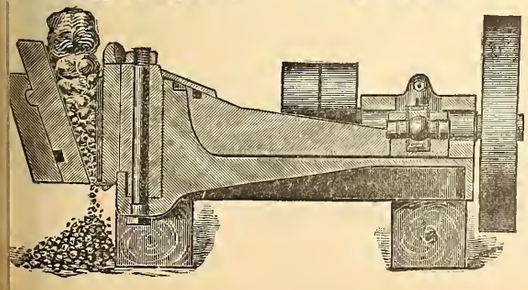

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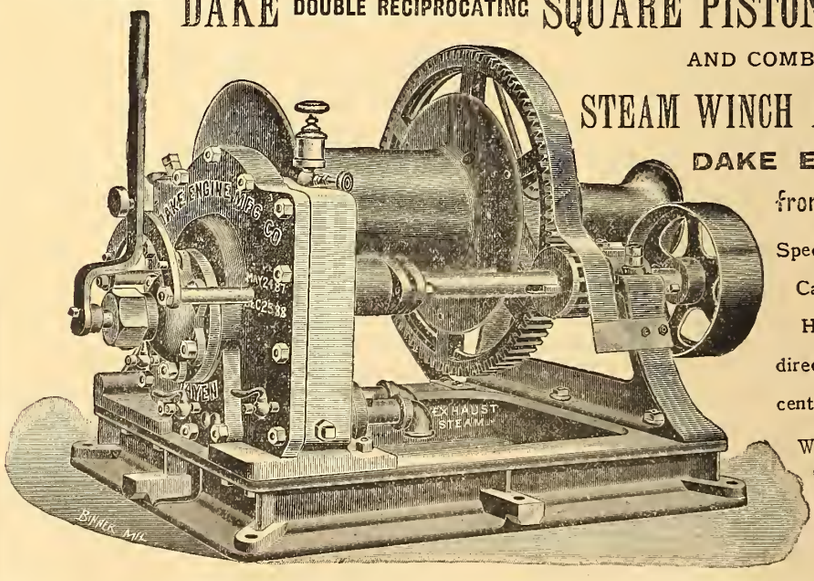

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Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

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SOME REMARKABLE RESULTS IN GOLD EXTRACTING.

New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. & Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

W. D. Sutherland, Secretary of the Salisbury Gold Mining Co., of Nova Scotia, after having over 4 tons of ore treated by the Crawford mill, says: "Sample of the tailings taken during the run showed by assay an equivalent to 0.033 oz. to the ton. This evidence of the capability of the Crawford mill to extract all but a trace of the gold which the ore may contain must be considered of importance by all who are interested in the question of improved methods of milling gold from the ores. The test alluded to was made under the supervision of our company through trustworthy agents."

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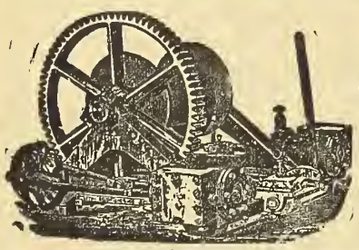

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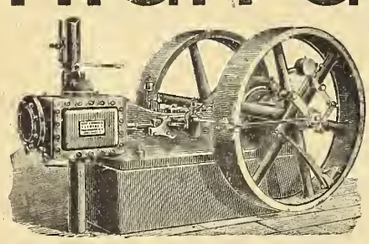

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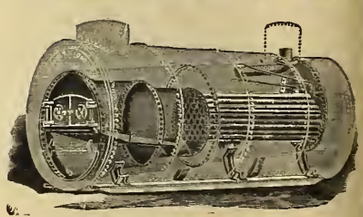

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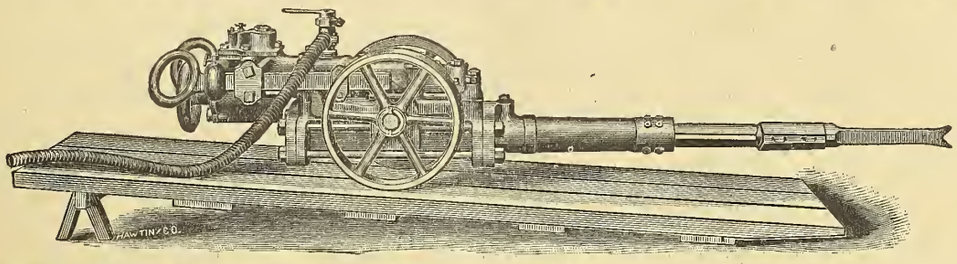

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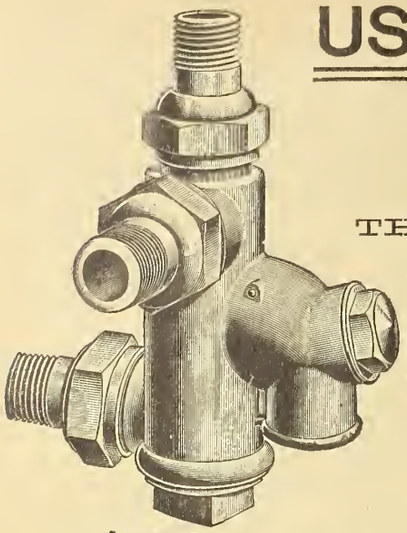

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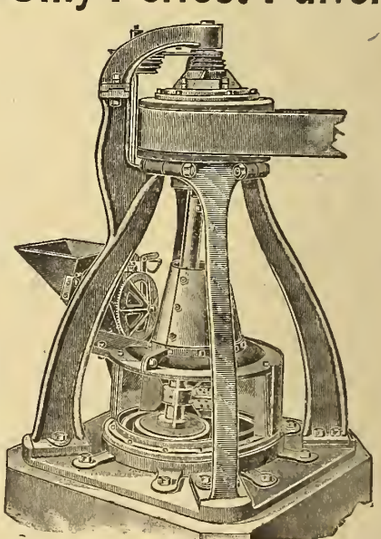

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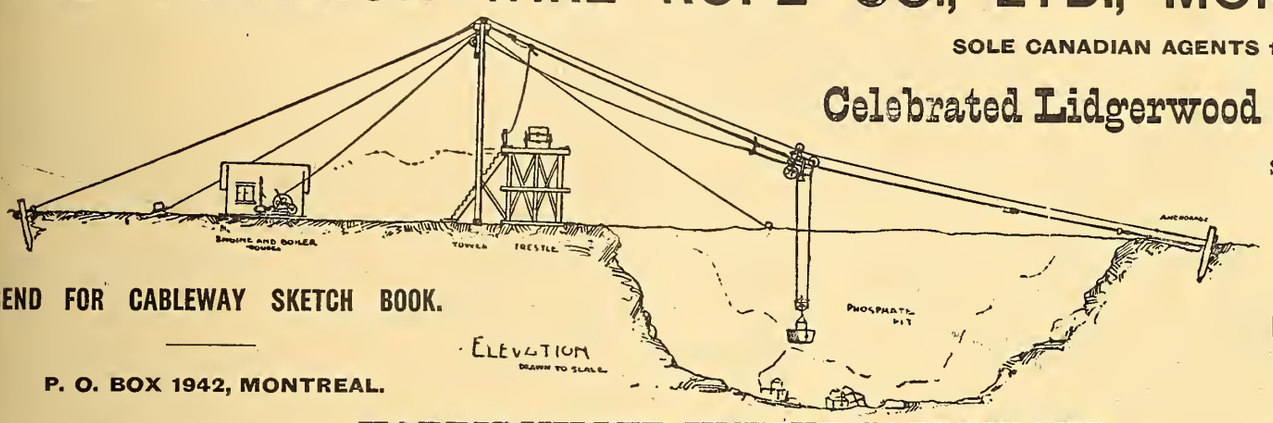

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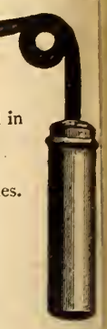

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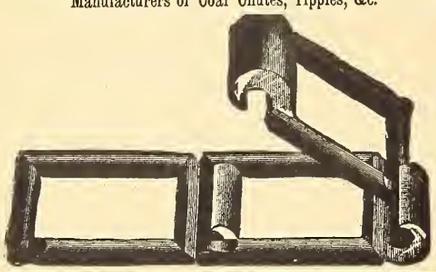

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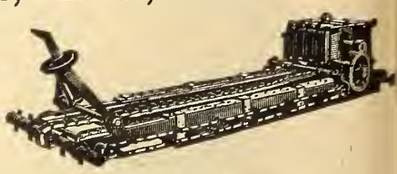

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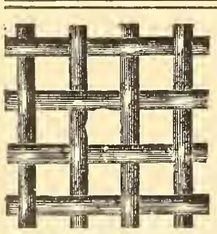

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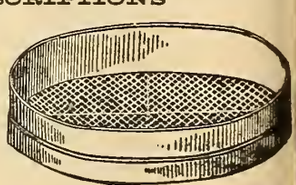

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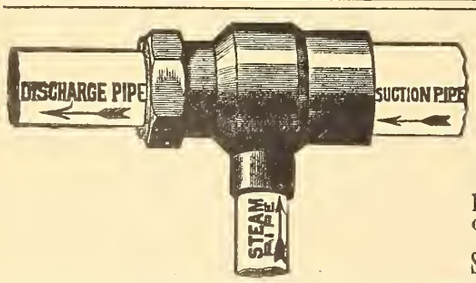

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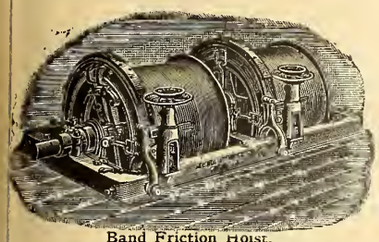

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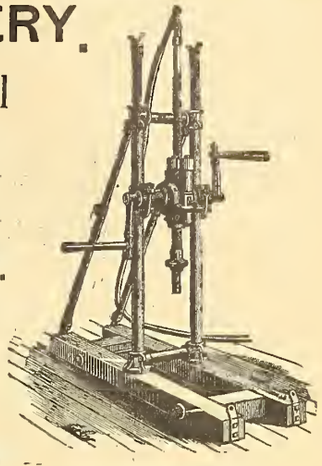

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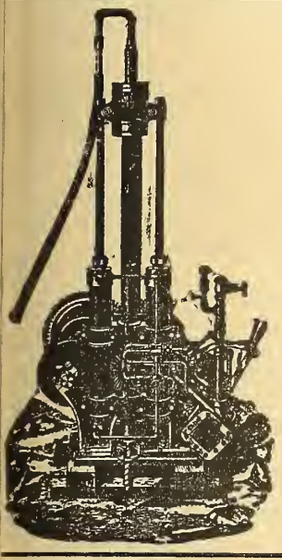

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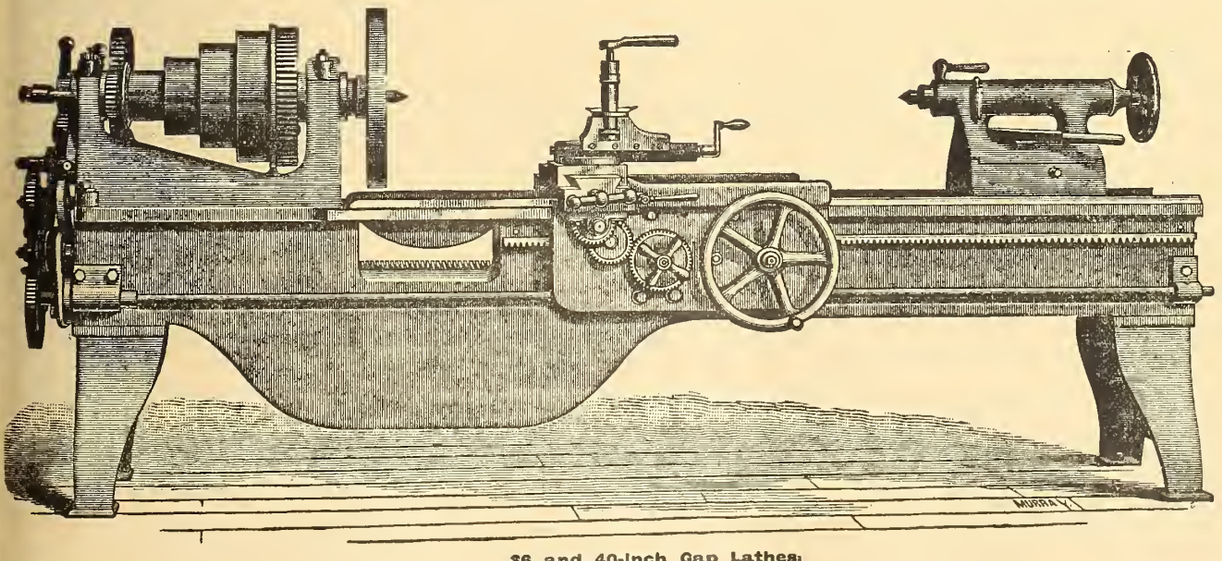

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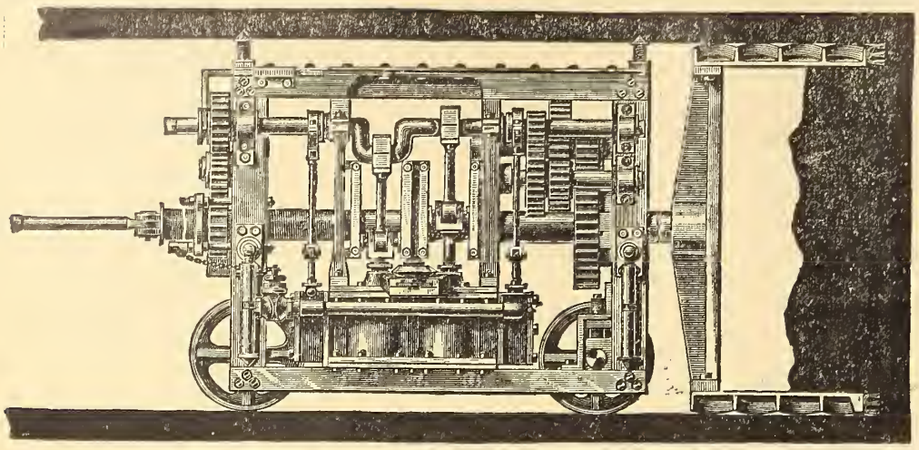

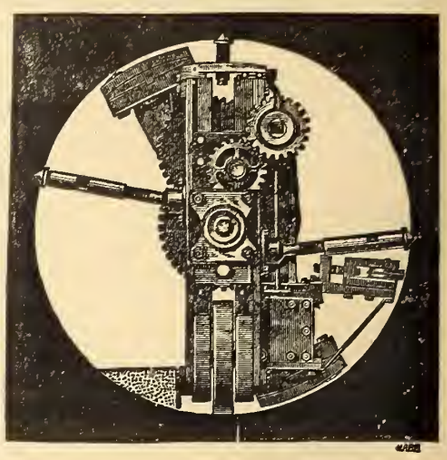

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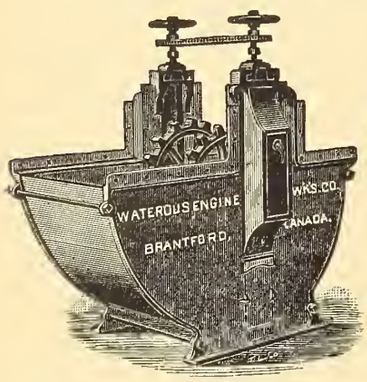

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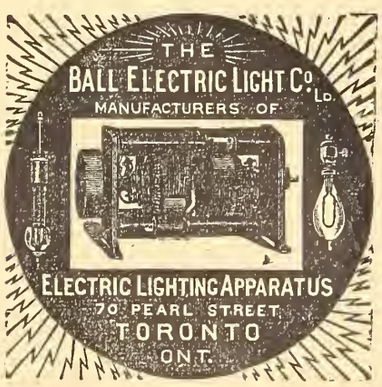

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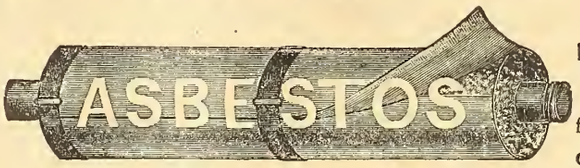

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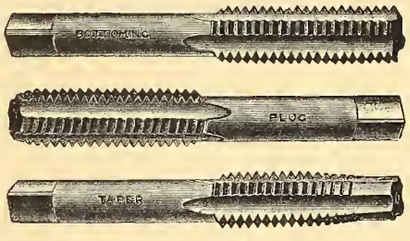

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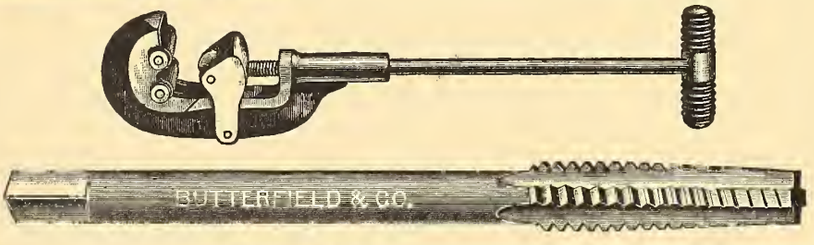

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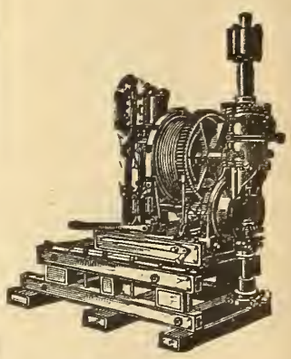

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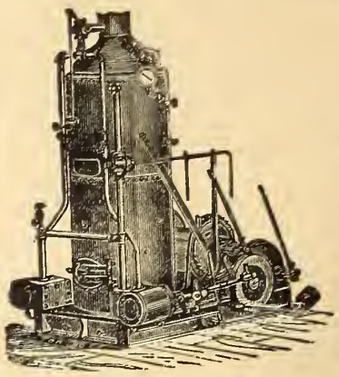

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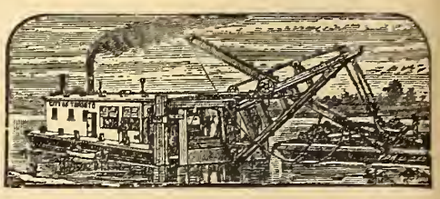

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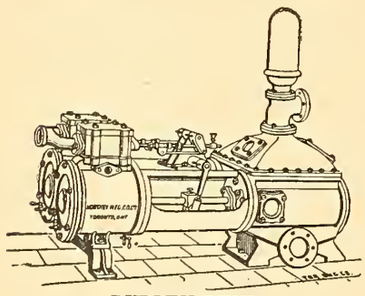

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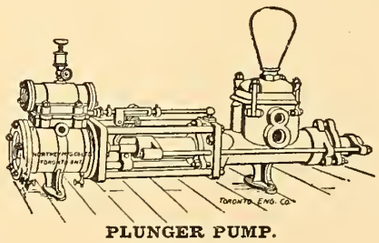

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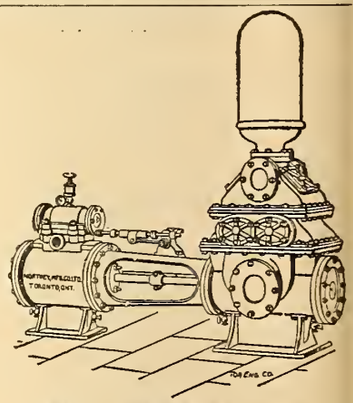

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CONDUCTED BY - - - - - - B. T. A. BELL.

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THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUE BEC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The Cape Breton Coal Trade.

Coal mining operations in Cape Breton have been carried on this year without any very noteworthy change from the *modus operandi* of preceding seasons. The winter and early spring months were filled with loud prophecies of impending disaster and ruin to the country, from papers and individuals whose interests—financial or political—were not furthered by the "Whitney Syndicate," so-called, and on the other hand with almost equally wild and absurd prognostications of glorious prosperity and immense benefits to one and all on the part of those disciples of the Hon. W. S. Fielding who were seeking to grind their axes at the Whitney whetstone. The result has been, as might have been foretold by any one acquainted with the shrewd business men who were controlling and putting their money into this venture, that prophecies of spiteful critics, and prognostications of foolish friends have alike proved false. "*Festina lente*" is not a motto that would naturally commend itself to those who, on the one hand, were clamoring for the immediate transformation of Cape Breton into an El Dorado, or, on the other hand, were crying out that the bottom must immediately drop out of the coal trade and of everything connected therewith, but it is the motto that the Dominion Coal Company has evidently adopted for itself at the present juncture. They evince no disposition to spend their money on hastily matured schemes, and are provokingly deaf to the gibes of their numerous critics and advisers, who taunt them with not scattering their money broadcast through the country by undertaking out of hand gigantic operations which have been promised and vowed in their name. None the less, the extension of the railway from Bridgeport to Louisburg is being steadily progressed with, and other works which must entail a heavy expenditure of money, and which will give facilities for mining and shipping coal in increased quantities, are being anxiously and carefully considered, and will assuredly be carried out. In these, as in all other matters affecting their business, the Dominion Coal Co. will, we imagine, be guided entirely by a consideration of their own interests, without reference to the interests of either political party in Nova Scotia. It has been amusing, for an observer outside the arena, to follow the local papers in their attitudes towards the new company. On the one side we find unreasoning and unreasonable opposition all along the line, the manufacturing of unfounded stories of rapacity and tyranny, and the setting up of bogeys in the shape of dreadful consequences that were to follow the change of ownership in the mines, which any driver-boy in the company's employ could have knocked down. On the other hand we find a complacent fathering of the new enterprise as the party's own particular bantling and property, with encouraging exhortations, not to be afraid of nasty people who throw stones at, and say disagreeable things about the bantling, but to trust to, and lean upon the party, and all will go well.

It is puzzling to an outsider to see just exactly what the Dominion Coal Co. has to do with either party, in the way of being dependent upon it.

Mr. Fielding, on behalf of the Province of Nova Scotia, made what is generally conceded to be a favorable business arrangemeut with Mr. Whitney and his associates, but we do not conceive that it was a part of the bargain that the Dominion Coal Company should become a subservient attachment to Mr. Fielding's political machine. The astute little premier of Nova Scotia is deserving of all credit for having made a good bargain. It is one that the Conservatives would, no doubt, have readily made had they happened to be the "ins," but since, unfortunately for them, they were the "outs" at the time, they feel sore about it and can see nothing but evil in the whole business.

It appears to us that politicians in Nova Scotia, who apparently number about nine-tenths of the population, have conceived altogether erroneous ideas as to the Dominion Coal Company's objects and destiny in Cape Breton, and the sooner they grasp and digest the notion that the company is an ordinary commercial undertaking, whose primary and prevailing object in calling it into existence was to make money, the sooner shall we be spared the reading of very nonsensical paragraphs and letters, whether directed against or in defence of the company, in the local press.

We learn that in spite of a somewhat late and slow start, the output of coal has, so far, been considerably in excess of the quantity put out up to the same period last year, the only falling off being from Cow Bay. This increase is shared in by the General Mining Association, the only company not controlled by the syndicate, whose collieries of Old Sydney mines and Victoria, have been doing a good business. Operations at the Dominion Coal Company's collieries have, as before stated, been carried on pretty much upon the old lines, the only observable change being the centralizing of the management at Glace Bay, where the popular resident manager, Mr. David McKeen, M.P., resides, and whence he directs the net-work of collieries lying around him with a youthful energy which excites the envy and admiration of his friends and subordinates. Meantime, works of development are by no means lost sight of. The Louisburg railway is under construction, half the distance being actually contracted for. The question of providing better and increased shipping facilities in Sydney harbour is one that is engaging the earnest consideration of the management, and the opening of navigation in 1894 will doubtless see the company equipped with a wharf which will enable them to compete with any coal shipping concern on this continent in giving prompt despatch to vessels.

A new locomotive, the "H. M. Whitney"—(a replica of the famous "Sir Donald," built by the Rhode Island Locomotive Works for the late International Coal Company), weighing 60 tons, and capable of hauling 600 tons of coal at a trip with ease, has just recently been added to the rolling stock, and 100 new 10 ton coal hoppers are now arriving by instalments from the Rhodes & Curry Works at Amherst, so that the opening of another shipping season will find the company well provided with rolling stock wherewith to feed their new wharf. An increase in the output of coal will probably be brought about by a development of the Old Bridgeport area, on which it is in contemplation to sink a new shaft. The erection of shops for machine work of all kinds at Glace Bay is also under consideration, and altogether, the Dominion Coal Company, without going ahead with that frenzied haste expected of them in some quarters, is giving substantial evidence of a vigorous policy, not evincing the slightest disposition to ruin the country by closing down the mines or to injure it in any other way. That they ever desired or intended to do so, no sane person can really have imagined, but political exigencies are sometimes responsible for wild and foolish ideas. Having been pretty roughly handled at the outset, and peppered at by skirmishers all along the line since its march began, we hope they may now be allowed to continue on their way unmolested, until such a time as they may give evidence of those cruel and evil intentions which have been so freely imputed to them.

Lightning in a Nova Scotia Mine.

A recent experience in Nova Scotia serves to repeat the saying, "that a miner's lot, like the policeman's, is not always a happy one." Westville, in Pictou County, was recently visited by an unusually heavy thunderstorm. First the office of the Intercolonial Coal Company was struck and seriously damaged, the inmates, fortunately, escaping injury. A few moments after it was found that the lightning had hastened underground by the Scott shaft, a few yards from the office. The lightning appeared to have struck the pulley wheels, some forty feet above the ground, and to have travelled down the wire rope, on to the iron sheets at the pit bottom, and thence into the workings by the rails. Here at some point the sparks found gas and ignited it. There are on record several cases of lightning having descended the shafts of coal mines, and then traversing the workings by the haulage ropes, rails, etc. Rude shocks have been felt by the workmen along the track of the unwelcome visitor; sparks have been noticed, etc., but it is not, it is believed, on record that lives have been lost or gas ignited.

In this case there was a somewhat violent explosion sufficient to derange the ventilating appliances. As the explosion was followed by smoke, it was apprehended that it had ignited the coal, and steps were at once taken to close the openings of the mine. At present the air is excluded so that if any fire exists it may be extinguished for want of oxygen. The pit had been idle for some time, and presumably gas had accumulated.

If the pit had been working with its complement of miners, presumably the danger of an explosion in this case would have been slight, as very great attention has always been paid by the management to its ventilation. Still, as in many mines, especially those of considerable extent, there are old workings and falls liable to accumulate gas, it can be readily imagined that the lightning's erratic course might encounter gas enough to cause disaster. Fortunately this accident occurred in daylight, and prompt steps could be taken to protect the workings, and it is to be trusted that the experience gained may be of service to the mining world.

The erection of lightning rods would at first sight appear to promise a safeguard, but there would generally be a difficulty about collieries in providing a proper earth, and again, the presence so close to the conductor of the large rope, leading generally to a close connection with a water lodgment at the bottom of the shaft, the wire guides for the cage, etc., might neutralise its good effects even if it were provided with a gilt tip. Experience bearing on these points, and possibly of great interest, might have been secured in this case had it been possible to have examined the pit shortly after the explosion.

The point of contact of lightning with the earth appears often to be decided on grounds other than of the presence of large masses of iron. Cases are not infrequent where lightening has struck within a few yards of pits, engine houses, boilers, etc., without apparently displaying a preference for them. It might be found that the most efficacious method of protecting similar plants, would be the erection of a conductor in their near vicinity, rather than at such points as an engine house, pit head, etc. Electricians have here a field to exercise their ingenuity, and no doubt colliery owners would readily pay for any effective means of guarding against so formidable a visitor.

Mining Machinery at the World's Fair.

In commencing a review of the mining machinery at the World's Columbian Exposition, it may be well to state at the outset that the exhibit is not remarkable for novelty or unusual merit. There are many creditable individual displays but they are composed chiefly of standard machinery with which most are familiar.

The most complete single display is that of Fraser & Chalmers (Union and Fulton Sts., Chicago). The most noticable single item and the one which attracts the most attention is a mine pumping engine fitted with the Riedler water valves and valve gear. The machine is of 30 in. stroke with differential water plungers 6 and 8 inches diameter respectively, and is regularly driven at the astonishing speed for this class of machinery of 75 turns per minute. Of course it has no head of water against it, its only work being to pump from a tank to its dicharge pipe, which in turn empties the water back again into the tank, and it is impossible to say how the machine would work under a heavy lift from its action under the above circumstances, but it is only fair to say that running as it now does it is absolutely quiet. The machine is of the duplex pattern, driven by a pair of Corliss engines, somewhat similar to the standard construction of duplex air Compressors, and is in every way a most creditable appearing machine.

Of the standard styles of machinery and appliances in this exhibit should be noted a 9 x 15 crusher of the Blake type, a pair of Eckarts fine crushing rolls of the latest and most improved pattern, the size being 26 inches diameter by 15 inches face; a link motion single drum double cylinder hoist, the drum being 30 inches by 42, fitted to operate a cage hoist which descends through the floor where it connects with the track of a typical mine drift, which extends across and below the Manufacturer's Building and of which more later; a single cylinder single drum hoist arranged with a belt pulley for driving other machinery and intended chiefly for preliminary work; a Morel ball pulverizer, in appearance somewhat like a Crawford mill; a complete 42 in. x 120 in. water jacket lead furnace with a complete equipment of slag pots and all accessories; a Chilean mill with 8 ft. rolls weighing 8½ tons each; screens of various patterns built up and otherwise; mortars wet, dry, and sectional for mule back transportation; retort and bullion furnace; Huntington mill, connected to a 6 ft. frue vanner; a complete five stamp quartz mill, connected with two 4 ft. frue vanners, the wearing parts of the mill being of ferro alumina, and last but not least, two Bridgeman samplers which to us at least are novelties. The larger of the two has a capacity for passing twenty tons of mineral per hour, and taking therefrom as a sample, various portions ranging between 1/32 and 1/128 part depending upon adjustment. This machine acts upon the principle of taking the entire stream a fraction of the time for the sample and it consists of a number of revolving rings, arranged one above the other and revolving at different speeds. These rings contain shutes occuping a portion of their circumference. The upper ring revolves so as to bring its chute from time to time below the chute from the ore bin. The stream of ore flowing from the bin chute through the ring chute constitutes the first sampling, the ore, when the ring chute is away from the bin chute, passing from the sampler at once. In a similar way the second ring takes a sample from the first sample, and so on in succession. The entire machine is very compact and mechanical in construction and appeared well adapted to its purpose.

Next to the exhibit of Fraser & Chalmers, across one of the transverse aisles is the exhibit of the Rand Drill Co., and removed a sufficient distance to prevent active hostilities and to render the intervening ground safe to the visitor, is the exhibit of the Ingersoll Sergeant Drill Co. Each company shows a line of drills mounted in various ways as well as compressors, the exhibit of these machines by the Rand Co. being the largest and most complete. The Rand exhibit comprises both Little Giant and Slugger drills, the latter in one case fitted with the "Derby" bit, which is probably a novelty to most of your readers. It is a star shaped bit attached to the end of a piece of hydraulic piping, which in turn fits into the usual chuck. The piston rod of the drill has a hole through it which has a connection with the upper head of the machine, through which a constant stream of water or air is supplied to the bottom of the hole, where it washes away the cuttings as fast as formed, giving always a clean bottom for the bit to work on and preventing clogging of the bit and consequent delays from accumulation of mud. The shape of the bit is such as to pass seams and other irregularities in the rock without the delays which occur with the usual style. Included in the display are compressors of the straight line, duplex water power, and duplex steam power types, the largest of the latter, a 14 x 22, being shown at work. There is also included a vertical three stage compressor for pressures up to 4,000 lbs. to the square inch.

The display of the Ingersoll Co., includes drills of various sizes and mountings, bar and track channelling machines, gadder, coal cutters and a 16 x 18 straight line piston inlet compressor at work.

Both the Rand and Ingersoll companies have an additional exhibit in Machinery Hall of large

duplex compressors. The Ingersoll machine has compound steam cylinders and piston inlet air cylinders. The Rand has both steam and and air cylinders compounded, the latter being fitted with their mechanical valve gear and having an intercooler between the low and high pressure cylinders. Both machines are fitted with Corliss steam valve gear and are shown at work, the air made by them being used throughout the exhibition grounds for various purposes. In connection with them is a number of Norwalk compressors of the standard type, also in motion compressing air for the same purpose.

Adjoining the Rand exhibits is that of P. H. and F. M. Roots, (Connersville, Ind.) who shows a line of their positive blowers and gas exhausters. There is a number seven blower coupled with a vertical engine on the same bed plate intended for foundry use, and having a capacity of 23 tons of iron per hour, and a No. 6 high pressure blower also with engine upon the same bed plate and capable of sustaining a pressure of 12 lbs. per square inch. The gas exhauster has a capacity of 62,000 cub. ft. of gas per hour. It is fitted with direct connected vertical engine and has a beautiful automatic regulator for controlling the speed in order to maintain a constant vacuum in the retort regardless of the quantity of gas delivered. It is also provided with a by pass valve for use in case of failure of the exhauster. We are informed that the Montreal gas light company is provided with a full equipment of these exhausters. This exhibit also includes a small working model of their pneumatic slack and culm conveyor for coal mines, and a rotary pump having a capacity of 4,000 gal. of water per minute.

Adjoining the Root's blower exhibit is a space occupied by the Chicago Iron Works, the chief item of the exhibit being a superb 400 h. p. 20x48 Corliss hoisting engine. The engine is fitted with two flat rope reels, arranged for use either balanced or independent, it being possible to hoist with one reel while the other is lowering, by means of the brake, or one reel may be used for hoisting from various levels, while the other manipulates a bucket or kibble for shaft sinking and pumping. The engine has no friction clutch, but, instead, is fitted with Unzicker's positive claw clutch, this clutch being operated by a steam cylinder fitted with cataract. Each reel is fitted with a large dial indicator having two pointers, the second of which comes into action when the load is within about 100 feet of the surface. It moves at a much higher speed than the usual pointer and enables the load to be landed with greater accuracy. Steam brakes are provided for each reel as well as a safety device to prevent overwinding, this device closing both steam and exhaust pipes, and putting on the steam brakes. The link motion is also operated by a steam cylinder. Those accustomed to the more rough and ready character of customary mining machinery will perhaps criticise this highly organized machine as being an unnecessary piece of refinement, especially for one of its size, but the entire machine is worked out with an obvious painstaking in design and excellent workmanship, which bespeak its successful operation. It is by long odds the finest hoist on exhibition. This exhibit includes also a number of other items including a Chilean mill with three 44-inch rolls, two hydraulic giants, triumph concentrators, stamp mill, mortors, positive blowers, Hartz & Collom jigs, a steel jacket smelting furnace 33 x 84 inch, rolls, crushers, small hoists, etc. They also show what appears to be an excellent arrangement of screens in sets, the arrangement being the opposite from the customary one. The material is put into the *coarse* screen first, that which refuses to pass it being chuted to the proper bin, and that which does pass it being sent to the second screen where the operation is repeated. In this way the finer screens are saved from the destructive wear due to their being obliged to handle the entire bulk of material as with the usual arrangement.

Following this exhibit comes that of the M. C. Bullock Manufacturing Co., (1170 Lake Street, Chicago), who display seven sizes and styles of diamond drills for surface and underground work, together with hoisting engines fitted with the well-known Lane friction drum. Among their diamond drills is one which has a record of having drilled three holes of a depth of 2,026, 2,400 and 2,460 feet respectively; these being the deepest diamond drill holes in America, and so far as known, in the world.

Proceeding north we come next to the American Mining and Milling Machinery Co. (Cleveland, Ohio), who show a crusher and mill for pulverizing. The crusher is extremely compact, due to the fact that the jaw is driven directly from the eccentric without any intervening toggle joint.

Adjoining the above exhibit is that of the Gates Iron Works, who show a giant among crushers, with a capacity of 150 tons per hour to 2½ inches. They also show a set of Cornish rolls, and a complete working model of a ballast making plant with crusher, screens, storage bins, distributing car, etc.

In the same section is the exhibit of the Webster, Camp & Lane Machine Co. (Akron, Ohio), who show a double drum first motion hoist, with slide valve engine 20 x 42, and fitted with Lane's friction. They also show a smaller geared hoist with boiler and overhead works for a small shaft of iron. In the same exhibit is also a motive power Corliss engine 20 x 42.

Near the above is the Prospecting Mining and Machinery Co., (Portland, Oregon), who show the Tremain steam stamp, which is a duplex machine built of iron extremely compact and working extremely well. This two stamp machine is claimed to be equal to a regular five stamp mill, and to be smaller, easier of transport, and in every way more desirable.

Across the aisle and still going northward is the exhibit of the H. W. Johns Asbestos Co., (New York), whose exhibit attracts a large amount of attention. They show a large line of asbestos goods, including fine decorated cloth, similar to theatre curtains, and one is surprised at the list of theatres which the attendant showed him as having been fitted out with these curtains. The most attractive portion of this exhibit, however, is the display of machinery for making asbestos cloth, including carding machine and loom, which are shown at work. The carding machine is very similar to that used for wool, the chief difference being in the cards, which are composed of No. 32 wire instead of 27 or 28, which are used for wool. The loom is very similar to a cotton loom, but heavier and run at a much slower speed. The spinning is not shown, but your correspondent is informed that it is done upon a mule. There is also shown a braiding machine for use in making asbestos packing, also specimens of asbestos rope which have been broken in a testing machine to determine the strength of the rope. The test was made both dry and after prolonged soaking in water. The dry rope showed a strength of 4,400 lbs., and the wet rope of 1,800 lbs.—the size being one inch.

In this connection should be mentioned the exhibit of our friend Mr. L. Wertheim, (Frankfort, Germany), of asbestos goods of all kinds in Machinery Hall. This exhibit of manufactured asbestos goods is the most extensive in the exhibition and includes a full suit of asbestos cloth mounted upon a clothier's dummy. It also includes a toy theatre with the scenery painted on asbestos cloth, and fitted out with gas jets playing upon the scenery to demonstrate its fire-proof character.

Next in order comes the Bradley Fertilizer Co., (92 State St., Boston), who show the Griffin mill in three sizes. (Manufactured in Canada by the Jenckes Machine Co.) These machines are connected with power so as to be shown in motion to illustrate their very peculiar action. The exhibitors, however, have respect for the ears and nerves of visitors and show the mills in action only when requested to do so.

Near the Bradley Co. is the Mechanical Gold Extractor Co., (47 Broadway, New York) who show the Crawford mill both full size and by a working model.

Following them is the Steam Stone Cutter Co., (Rutland, Vermont), who show the Wardwell Channeller, both the old style or drop type for vertical channelling, and the new or universal type for angle channelling.

Near them is the Sullivan Machinery Co., (Claremont, N.H.), who show seven sizes of diamond drills and two styles of channelling machines—the sandstone machine for vertical work and the marble machine for universal work. The first of these is in very extensive use on that immense work, the Chicago drainage canal, which is to be 160 miles long, 120 feet wide and 30 feet deep—a genuine artificial river. About fourteen miles of this work is through solid rock and the sides of the excavation are being channeled by the Sullivan Company's machines. If a section of this canal could

be transported to the exhibition grounds, it would form one of the most interesting exhibits there.

The Sullivan Company also show a considerable line of coal mining machinery, including the Stanley entry driving machine which, however, retains the inventor's mechanism only in the cutter bar. The most marked change is the entire abandonment of track and wheel for carrying the machine. In their stead appears a simple shield of boiler iron which slides upon the surface made by the cutter bar. The machine is thus capable of continuous action without any delays from track laying. The machine is also fitted with a new feature consisting of a conveyor for carrying the cuttings away from the machine to the car. The coal mining machinery shown here comprises coal cutters of the cutter bar type for both room and pillar and long-wall systems of mining. They also show a gadding machine for marble quarries.

In coal cutting machines there is also an extensive exhibit by the Jeffrey Manufacturing Co., (Columbus, O.) who show the well known Jeffrey Mining machine both electric and compressed air, and fitted for work. They have a large mass representing a make-believe coal seam, constructed of the universal and protean staff, with the coal machines arranged for running under it, thus illustrating very clearly the method of operating. One of their cutters is mounted upon a truck to the wheels of which its motor is geared so as to act as a self propeller. The wires are strung along the roof of the entry and approximately parallel. The trolley has double wheels for contact with the two wires, and is taken in the workman's hand and held in contact with the wires, the workman following the machine on foot. Of coal mining machinery they also show coal drills, both electric, compressed air and hand power. They likewise show a rotary electric pump mounted on truck, and provided with suction and discharge hose for portable use about the mine. In the same exhibit is a line of link belt elevators and conveyors of various patterns in connection with screens for a variety of uses.

In immediate proximity to the last named exhibit, is one by the Nelsonville Foundry and Machine Co. (Nelsonville, O.), the chief item of which is an excellent double cylinder double drum geared friction hoist, which of its class is the finest on exhibition.

Several foreign exhibitors show mining machinery in connection with their other exhibits in Machinery Hall. Among these are the Rio Tinto rock drill, which is exhibited by a gentleman whose method of explaining the numerous claims of his machine would excite the envy of any Yankee rock drill salesman, and unlike some others that we have seen he really seems to believe all that he said. Near by in the same building is the Daw drill, now famous in the annals of our General Mining Association of Quebec.

The chief exhibit of mining machinery in Machinery Hall is, however, that of the great Fried Krupp, Grusonwerk, (Machinery Hall, Columbian Exposition.) The first item noticed in this exhibit, is a rock crusher of the Blake type with steam engine attached. This machine is constructed with all of its chief parts of steel, and sectionalized for mule back transportation, the heaviest piece weighing 300 lbs. The size of the crusher is 16 x 10 inches. The workmanship and construction upon this machine, which is shown in operation, like that of all the Krupp exhibits is of the most superior character. The fly wheels of the crusher are made with hollow rims, in order to save heavy pices in transportation, the intention being that the hollow spaces shall be filled with lead after the machine is set up. Another machine in the exhibit is a worm mill, for the mixing and coarse grinding of various ingredients for the manufacture of Portland cement, and similar work, and along side of it is another machine for mixing materials in fixed proportion according to adjustment, the materials being taken by the machine from suitable hoppers. The machine shown is adapted for the mixing of two ingredients only, but they are made for the mixing of any number of ingredients, and the extremely courteous and obliging attendant assured me that the machine was extremely accurate in maintaining a proper proportion of the ingredients. This machine like the preceding one is largely composed of steel and chilled iron.

The largest and most striking item of display is a Chilean mill, with rolls two meters diameter, twenty centimeters face, and weighing twelve thousand lbs. each, the tyres being of cast steel.

A novelty in this machine is in the construc- of the crank axle, the crank pins being set at an angle of six degrees less than a right angle with the cranks. In other words, the plane of the wheels is not tangent to the track in the mortar, but the wheels look inward in the direction of the motion, thereby obviating the constant pull of the wheels upon their journal, due to their tendency to follow a tangent to their circular track. This machine like all the others in the exhibit shows a degree of care and refinement in the design, workmanship and finish, which seems almost sacrilegious in machinery intended for such purposes.

To us, however, the most interesting item of the exhibit, was a number of ball mills. We have seen ball mills before and likewise foundry rumblers, but these machines are of a very different order of architecture. The largest of the lot has a drum 8 inches diameter, lined with steel plates, and intended to carry 1900 lbs. of steel balls 4 to 5 inches diameter. The machine is continuous in its operation, the feed being through the center and automatic, and the discharge being through a spout at the bottom of a boiler iron case which surrounds and encloses the entire machine. The machine is fitted with screens so that all of the material discharged is pulverized to the required degree of fineness, and by a beautiful and unique arrangement the material which refuses to pass the screens, is automatically put back into the mill to be re-ground. This is accomplished by the arrangement of the plates which comprise the circumference of the drum. These plates are arranged with an opening between each pair, this opening being tangential to the circle of the drum. Each plate passes by the other at this opening, so that in the direction in which the machine turns the material within the drum falls from one plate to the next like water on a shingled roof, but the material which passes through the holes provided, is caught upon the screens which travel with the drum, and are provided with ribs which catch the material too coarse for the screens and carry it upwards to the top of the machine, where the plates no longer act like shingles, but allow the material to fall back through the openings discribed. The screen is also protected by a coarser screen within it to save wear. The writer was shown material ground by these mills to pass through a screen of 200 meshes to the inch., and the work seemed perfect. The mill is said to be in very extensive use in Germany, 16 being in use at one cement works, where the entire set is attended by two men, all of which would indicate that a knowledge of the art of saving labour is not confined to New England.

There is also shown in this exhibit, a concentrating plant for fine ores and slimes, consisting of hydraulic classification machines, jigs and percussion tables, all upon the Bilbarz system.

Entirely without the buildings with one terminal at the mining building directly over the extremity of the Fraser & Chalmers' mine level, and with the other at the western boundary of the exhibition grounds, is a complete wire rope tramway by the Trenton Iron Co., and of their Bleichert system. This is in every respect a full working tramway, its length being about 1,000 feet, and its capacity 20 tons per hour. It has four intermediate supports between the terminal stations, built of iron in the most substantial manner, two of them being 40 feet high, and conducting the tramway over the intramural elevated passenger railway. The tramway is driven by a Thomson-Houston five-horse power electric motor. Our readers are no doubt acquainted with the Bleichert system, and it will be unnecessary to do more than give a general description of it. It is of the double rope type, the main or carrying cable being of the locked coil construction, and the smaller, or driving cable, of the usual pattern of wire rope. The line is equipped with a full outfit of ore buckets, with switches and turnouts for the full and empty cars at the terminal stations, together with a lowering device for dropping the loads to the mine cars of the Fraser & Chalmers' drift. The tramway is in daily use transporting the diamondiferous blue ground of the DeBeers Mining Co. of South Africa, who have a large quantity of this diamond-bearing rock stored at the further terminal of the tramway, where it is guarded by a force of Zulu warriors. This rock is transported across the exhibition grounds by means

of the tramway which drops it into one of the Fraser and Chalmers' mine cars. In this car it is carried across and below the mining building, where it is hoisted by a cage hoist to the level of the floor, in the middle of the Fraser & Chalmer's exhibit. It is here put through two crushes, coarse and fine, and is then carried to the main exhibit of the DeBeers Mining Co., in connection with that of Tiffinay & Co., of New York, in the center of the Mining Building. Here is shown the complete process of washing, sorting and cutting diamonds. This exhibit, as may well be imagined, forms one of the most attractive in the entire exhibition, and is constantly surrounded by an eager throng of sight-seers. The separation process is extremely simple, and consists first in the thorough incorporation of a certain amount of water with the crushed rock. The mixture is then put through a simple jigging process for the complete removal of the finer particles, leaving behind only the clean broken rock with the diamonds distributed through it. The jigs have, however, a conveyer arranged in the over-flow trough, which carries any of the coarser particles or diamonds which may accidentally be washed over, to an elevator, which carries them back again to the jigs. The actual separation of the diamonds is performed by hand, upon an iron table, over which the crushed material is spread thinly by a tool provided for that purpose. The rough diamonds are much less rough than popular opinion makes them, and their selection is attended with no uncertainty, except that growing out of the extreme monotony of the work. This causes an occasional diamond to be overlooked, and the whole material is therefore gone over a second time and by a different man. The labor employed at the mine is entirely native, with white overseers, and the most elaborate precautions are taken to prevent pilfering by the men employed. These precautions are largely assisted by the laws of the District, which make it a criminal offence for any one to have in his possession an uncut diamond for which he cannot give a proper accounting. The white men who pick out the diamonds are not included in these stringent regulations of the general labor, but they are, however, under heavy bonds It is proper to add that the crushing process is not employed at the mines. The diamond-bearing rock has the very convenient property of disintigrating when exposed to the weather, and the rock is exposed for a period of about eight months, upon levelled and prepared pieces of ground for that purpose. The crushing process is employed here to expedite the work, and at the expense of an occasional chipped stone. The Tiffinay exhibit in connection with that of the DeBeers Co., shows the entire process of chipping and polishing the stones, there being four lapidary's wheels at work. The value of the diamonds shown aggregates three-quarters of a million dollars, and with them is a collection of specimens of the blue ground with the diamonds exposed in the fractures.

The yield of diamonds averages about one and one-quarter carets for each cubic yard of rock, although, of course, the ore shipped to the exhibition, is much richer than this. We were fortunate enough to see two diamonds discovered from the mass of broken rock upon the table.

It would not be proper to conclude this article without a notice of the really superb models of mining operations which are shown in various parts of the mining building. In the Pennsylvania section is a complete model anthracite coal breaker by the Philadelphia and Reading Coal and Iron Co., having an entire length of 24 feet. This model illustrates both slope and shaft work —for it must be remembered that in Pennsylvania nothing is a shaft which does not descend vertically in the earth. Underground wire rope haulage is also shown in this model, together with a section of an ideal anthracite mine. The entire model is a working one, all the operations being performed by model engines which are driven by compressed air from the general compressed air supply, already described.

In the Michigan exhibit are several almost equally interesting working models. Among them is an automatic dump skip and balance car, which illustrates an existing plant at the Central copper mine. This is upon a system which has become quite popular in Northern Michigan, by which the skip is balanced by a dummy car, running down an old and disused incline, the skip itself being in a vertical shaft. By this system nearly all of the advantages of balance cages in pairs are secured, excepting of course, that the output is not as large as with double cages. At the same time the expense of the larger shaft is saved.

Near the above is a model of about 10 feet square, showing the combined rock and shaft house at the famous Tamarack shaft. This is a vertical three compartment shaft three thousand feet deep, worked by a balanced Allis engine, one of the finest upon the entire peninusula of Michigan. Two of the compartments are employed for hoisting, and the third for pumping and lowering of timber. Along side of this model are others from the Calumet and Hecla, one being a shaft and rock house, similar to the above but connected with an incline shaft which is shown in section to the depth of the first level, where is shown a typical Calumet and Hecla arrangement of ladder ways, tracks, etc., for the handling of the ore. The other Calumet and Hecla models show the stamp mill of the Company, one being the old mill fitted with Ball stamps, and the other the new mill with the modern giant Leavitt stamps, together with the jigs and slime tables belonging thereto.

One of the best models in the exhibition, is that of the H. C. Frick Coke Co., which is located in the gallery of the Mining Building. It comprises two complete shaft houses, one for vertical shaft, and the other for slope work, the latter being shown in connection with a set of coke ovens complete with charging cars, etc. The ovens are fitted with burning gas jets to add to the realistic effect. The vertical shaft house has a model shaft descending through the floor, and fitted with a complete balanced cage hoist.

The model of the Gates Iron Works, showing a complete ballast making plant, has already been described.

There are a few pieces of mining machinery of which we were unable to obtain information, owing to the absence of any attendant. This is especially true of the foreign department. The chief item of this description, was a large size buddle table in the German department which had no attendant, but referred inquirers to the Commissioner of the German department. Repeated attempts, however, failed to obtain any circulars or other information. It passes comprehension to understand how foreign exhibitors can go to the heavy expense of making exhibits, and then leave them in this condition.

EN PASSANT.

Dr. C. LeNeve Foster, in a recent paper, offers a few suggestions for improving the mineral statistics presented in government reports on both sides of the Atlantic. In Canada there is great need for reform in this regard. At the present time the reports from the Division of Mineral Statistics and Mines in connection with our Geological Survey are issued altogether too late to be of any practical service to the mineral operator ; while the lack of uniformity and completeness in their compilation when published is so apparent as to render them absolutely unreliable. We venture to say that no one in this country, with a knowledge of its mineral development regards these reports as a faithful picture of the state of our mining industries. Indeed the opinion is unanimous throughout the mining men of the country that this branch of the public service requires a thorough overhauling. We are quite aware that many difficulties hamper the work of the officer in charge, but be the responsibility where it may, it is high time that the Hon. the Minister of the Interior, or Dr. Selwyn, made some well directed and energetic move to publish these statistical reports earlier and in a more thorough and reliable form than at present. Dr. Foster calls attention to the many differences in method of making out government statistics, and strongly urges uniformity, or that the different governments shall at least add to their several reports one general complete table based on a uniform method of weights, measures and classification.

Until Congress decides what is to be done with the Sherman Act, the silver question is certain to remain chaotic, with more or less violent fluctuation in the value of the metal. Silver producers all over the world have begun to set their houses in order. They perceive the signs of the time are adverse and recognize that the repeal of the Sherman Act will take away the legislative prop which has so long kept their pro-

duct at a false level. In the United States, which produces some 55,000,000 oz. of silver annually—or about one-third of the total quantity raised in the world—nearly the whole has been purchased by the United States Treasury, hence it is not surprising to find that the mines in Colorado, Nevada, Utah and Idaho, are all closing down. In Mexico the output is being restricted. It is being practically stopped in Peru and Chili, and in Australia, even the great Broken Hill mines are shutting down. This means that the great majority of the mines cannot raise silver at anything like the present price, and it means, further, that the law of supply and demand is at last to be allowed to have unfettered operation. As prices rise again the better mines will come into the field afresh, and —unless unwise action should be taken by any of the Governments concerned—we may expect to witness a far healthier state of things than has existed for some years past. Under any circumstances a large amount of silver will be needed for currency purposes in India, China, South America, and all the silver-using parts of the world; but there will be no longer any avalanche hanging over the market—that is to say, if the United States Government decide to act cautiously with their stock; and it is highly probable that exchange with India, etc., will improve and remain steadier, with excellent results upon our trade with the silver-using countries. A side issue of some moment to our readers in the great argentiferous galena country now opening up in British Columbia is that which relates to the price of lead. As is, or should be, well known to them, a very large proportion of the silver raised in the United States and elsewhere has been obtained from argentiferous lead ores. The lead has been got and smelted for the sake of its silver contents, the lead itself being treated as a sort of by-product. Henceforth this state of affairs will not exist. It will not pay to get the silver at present prices; consequently many of the mines in the Leadville district are being closed, and the reasonable inference is that the output of lead will be greatly restricted so long as existing conditions prevail. Inferentially, therefore, lead should improve in price before long. Any marked advance in values would enable many of our own lead mines to be worked at a profit, so that indirectly the latest phase of the silver question may have an important bearing upon our Canadian mining industries.

About two years ago Messrs. W. H. Greene and W. H. Wahl, were induced to undertake the search for a process for the production of manganese free from carbon upon a commercial scale. The results of their experiments are described in the Journal of the Franklin Institute. Starting from ordinary manganese ore, they found that nearly all the iron can be removed from pyrolusite, by digesting it with diluted (30 per cent.) sulphuric acid near the boiling point, ferrous sulphate being formed while the manganese peroxide is pratically unattacked. By this means the iron in a manganese ore, may in a few hours be reduced from 5 or 6 per cent. to a few tenths per cent., with a loss of manganese not exceeding 1 per cent., while the copperas that may be obtained by the treatment of the waste acid with scrap iron will pay the cost of the purification of the ore.

Numerous experiments upon the reduction of the ore by carbon have led the authors to the conclusion that it is impossible by a combination of methods to obtain a metal with less than 6 per cent. of carbon, and that it is equally impossible to remove the carbon so combined by fusion with oxidizing agents. The reason of this is seen in the results of some experiments lately published by Guntz, who finds that manganese is rapidly oxidized by carbonic oxide at a red heat with the production of manganous oxide and carbon. It will, therefore, be readily understood why pure manganese cannot be made either in the electric furnace or in graphite crucibles.

After many trials of electrolytic methods depending upon the use of baths of molten fluorides which led to no result, a method of reducing manganous oxide by aluminium has been worked out with complete success. This includes two operations; in the first the purified peroxide by exposure to the action of reducing gases at nearly a red heat is reduced to manganous oxide, a greenish grey substance which must be cooled out of contact with air to prevent its oxidation to Mn_3O_4. The monoxide is then mixed with about 18 per cent. of granulated aluminium and a suitable flux, which may be either siliceous or a mixture of lime and fluorides, and heated nearly to the melting point of cast iron in a magnesia crucible. As soon as the temperature of reaction is attained the mass fuses, and must be poured from the crucible while at its maximum temperature. The character of the flux has but little influence on the reaction, but indirectly it has an important relation to the yield and quality of the metal. If it is siliceous there will be some silicon reduced, and if it is too fusible, part of the aluminium may float up to the surface and become ineffective for the reduction. The best mixture has been found to be lime and fluor spar. Theoretically, one part of aluminium should reduce three parts of manganese ($3\,MnO + 2Al = 3Mn + Al_2O_3$), and working in crucibles on a small scale producing several pounds of manganese at one operation, the best result obtained has been 2·8 parts, corresponding to a reduction of 97 per cent., while the average yield has been 87 per cent. With aluminium at its present price, the authors therefore consider that manganese metal, with 1 to 2 per cent. of iron and silicon and free from carbon, may be prduced at less than 1s. 6d. per lb., this estimate including all expenses.

On the large scale it is proposed to conduct the operation in a reverberatory furnace with a magnesia lining, with a slight excess of reducing gases in the flame, which it is believed will retain the ore in the condition of lowest oxidation until the temperature of reaction is reached, when the prompt fusion of the flux will protect the reduced metal from contamination by carbon in the flame.

Having experienced a considerable difficulty in the preparation of magnesia crucibles, the authors adopted the expedient of lining plumbago crucibles with a stiff paste of calcined magnesite. When properly prepared these linings do not crack on drying, nor do they separate from the plumbago walls. They have been found to be very useful not only for the preparation of manganese, but in other metallurgical work where siliceous or plumbago crucibles were from any cause objectionable.

RING DOWN THE CURTAIN!

Misrepresentation, Extravagance, Boodling and Bad Management, Reduce the General Phosphate Corporation Ltd., to Insolvency, and the Great Big White Elephant Lapses into Obscurity "Unwept, Unhonored and Unsung."

To readers of the REVIEW no surprise will be experienced at this announcement. The inception of the Corporation as foreshadowed in the notorious green prospectus in 1889, and the questionable methods adopted in its promotion in the following year by Knud Sando, Mallaby Deeley, and others of that ilk—the enormous prices paid for undeveloped and comparatively worthless areas of mining lands to prominent Canadian politicians, the bluster and swagger and extravagance of its management both in Canada and in London, the revelations in the celebrated case of Stewart v. Wills—in fact the whole history of the ill-starred venture have been commented upon so fully in these columns as to leave no doubt in the minds of our readers as to the ultimate issue. While it is to be regretted that a number of very desirable investors have lost their money, it is more to be deplored that the fair name of the resources of our country should have been dragged in the mud by a parcel of unscrupulous adventurers. The following are the accounts of the last meeting of shareholders and the proceedings in court.

MEETING OF SHAREHOLDERS.

The adjourned meeting of the shareholders, directed to be held by Mr. Justice Vaughan Williams, for the purpose of ascertaining their wishes as to whether an order should be made on a petition, presented by Mr. George Mander Allender, to wind up the company compulsorily, was held at the Cannon Street Hotel, London, last month.

LORD STALBRIDGE, (the chairman), presided, and stated that the meeting was adjourned from the preceding Friday until that day, in order to see whether it would be possible to reconstruct the Company on the basis that the directors and their friends should find £50,000 to carry on the company. The directors and their friends had met and discussed the matter in all its bearings, and they had found it impossible to raise that amount. They could raise about £27,000, but £50,000 was beyond their capabilities. There were also some conditions attached to their lending the £27,000 which might be difficult to carry out, one of which was that all litigation should cease. There was no possibility of that, and, therefore, they must now consider what was best to be done in the interests of the Company.

SIR JAMES WHITEHEAD said a report had been issued by a committee of shareholders of the Corporation, which, more or less threw out insinuations against the directors, and in one instance an action had been brought, not only against the Company, but against the original directors. Under such circumstances it was impossible for the old directors to advance money to reconstruct the company. Those allegations must be met, and he, and those associated with him, would do all in their power to bring about a thorough inquiry.

THE CHAIRMAN, after a long discussion, moved: "That the Company be wound up compulsorily."

This was seconded and lost, four voting for and 70 against, which included 49 proxies of the shareholders' committee.

MR. JUSTICE WILLIAMS ORDERS THE CORPORATION TO BE WOUND UP.

On Monday, 25th ulto., Mr. Byrne, Q.C., presented a petition on behalf of G. M. Allentler, an original allottee, for the compulsory winding-up of the General Phosphate Corporation. The Company, Mr. Byrne said, had acquired certain phosphate properties, which, if not valueless, were almost so. Practically, no trade has been carried on, no profits had ever been made, and there was no property, except these phosphate properties, to reach which it was preliminarily necessary to construct a railway, and power had been obtained for this purpose. There was uncalled capital of £8 per share, and there were debentures to the amount of over £100,000. Interest, and Mr. Byrne believed capital, was due on the debentures, and there were no assets except the unattainable phosphate properties. The Company was commercially insolvent and could only pay its debts by means of calls. There were shareholders who were trying to get off the list on the ground of fraudulent misrepresentation, and it was probable that they would be successful. It was desirable, therefore, that the matter should be crystallised at once, in order that there should not be further shareholders going off the list at the expense of others.

MR. FAREWELL, Q.C., supported the petition on behalf of debenture holders to the amount of £84,000, and Mr. E. W. Ansell, also supported on behalf of four shareholders.

MR. DUNHAM opposed, representing nearly one-third of the capital. He stated that at a meeting of the Company 70 votes were cast against the compulsory winding-up and 4 in favor, and he protested against the presentation of a petition by a single shareholder against the feeling of the remainder. He argued that the Company could be profitably worked by the setting free of the uncalled capital.

MR. BUCKLEY, Q.C., appeared for the Company, and expressed neutrality as to the result.

MR. JUSTICE WILLIAMS, in giving judgment, said that, in his opinion, he ought to order the Company to be wound-up. Various grounds were relied on in the petition to support the proposition, but they all came to nothing, except the statement in paragraph 12, which said that the properties could not be worked by the Company at a profit, which, coupled with the other allegations in the petition, amounted to an allegation that the whole substratum of the business of the Company was incorporated to carry on had become impossible. There was one material statement, that having regard to the frauds in the promotion of the Company, a compulsory order was necessary to secure due investigation. He was, however, going to base his decision mainly on the ground that the properties could not be worked at a profit, and that in that sense the substratum of the Company was gone. He wished to add that it seemed to him that, in the case of a shareholders' petition not based on insolvency, there was no justice in hastening the winding-up in order that the opportunity of those who had been defrauded into taking shares from getting relief might come to an end. On the evidence before him, it was perfectly plain that the Company could not continue its business, so the only thing for him to determine was what the shape of the winding-up should be. In the circumstances, he thought the order should be a winding-up under the order of the Court, because there were allegations of fraud in the promotion and history of the Company, which allegations, it was plain, were believed by the committee of shareholders who investigated the matter.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Nova Scotia.

Caribou.

Mr. George W. Stuart has resigned the management of the Truro Gold Mining Co. at this place. It is understood Mr. Stuart was dissatisfied with the policy of the directors, and declined to withdraw his resignation. The property will be sold in September to effect a reorganization.

It is rumored that the owners of the old Moose River Co., which was so lavishly equipped by Mr. Scott some ten or twelve years ago, are desirous of selling, or effecting some transfer which will enable them to realize upon their investment. Something over $150,000 was expended upon the property.

Killag.

The reports from this district are to the effect that the Stuart lode, worked from the vertical shaft, is showing well. Several trial crushings have been made during the summer, which yielded from one ounce to five ounces per ton. There is no longer any doubt as to the lode being the Stuart lode, nor has the mythical "fault" yet materialized. The shaft still continues wet.

Fifteen Mile Stream.

Recent rumors of a rich strike here, upon investigation, have shown that a wonderfully rich pocket was uncovered, but that the vein as a whole will average about one ounce to the ton. The vein is large and big yields are expected.

Oldham.

The mill of the Oldham Gold Co. (Hardman & Taylor), was broken into on Sunday night the 30th of July, and amalgam and plates to the value of over $700 were taken. The stolen property was traced and the thieves have been tried and sentenced to the penitentiary for three years. Some $500 of the stolen property was recovered. The robbers were two brothers, Alexander and John Greno.

Montagu.

The Symon-Kaye property, represented by Mr. Alfred Woodhouse, of London and Halifax, is in the hands of tributers. No work is doing on company account.

Waverley.

This district is quiet. The East Waverley property (Tunnel Co.) is being quietly developed, and is showing large bodies of quartz.

The West Waverley Gold Co. have added ten more stamps, making twenty stamps dropping for the month of August. The yield for July was larger than usual.

Quebec.

We are informed that developments now going on at the Russell zince-blende mine, on Calumet Island, have recently uncovered a very promising vein of native silver lying on the under side of a large body of zinc-blende, at a depth of 30 ft.

Mr. F. B. Hayes, Ottawa, has a small force at work on his mica property at Lac Pied des Monts, about six miles back of Murray Bay. About three tons of white mica have been taken out at writing.

The Eustis Mining Company continues its usual force at Capelton, and shipping ore goes on briskly.

We regret to learn that the Nichols Chemical Company, who have been working the Albert mines, adjoining the Eustis mine, for several years, have suspended mining work. The Chemical and Fertilize Works, however, are said to be working full time.

The Danville Slate Co. (Messrs. J. N. Greenshields and F. Boas, of Montreal), have acquired the old Danville quarry and for several months have been quarrying with satisfactory results. The slate shown us is of the best quality, and Mr. Greenshields says us there is plenty of it.

Ontario.

The Copper Cliff, Evans, Worthington, Blezard and Murray nickel mines in this district are all working full force, and three of the smelters are kept going night and day, but the Drury mine is still closed down

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A Kingston dispatch states that a Pennsylvania company has purchased a quantity of iron ore from the mine at Calebogie. It will be experimented with, and if satisfactory the property will be purchased and operations resumed. Ore has not been shipped from that district for over three years.

British Columbia.

Kaslo District.

The dispute with regard to the Bon Ton and Big Bertha claims, which at first threatened to be seriously prolonged, has been amicably settled on the report of the surveyor, Mr. Ellacott, who made a joint survey of the two claims. Last year in August, men in the employ of Capt. R. C. Adams, of Montreal, discovered and located what they called the Bon Ton claim. Assays of picked samples ran as high as 1,250 oz. silver, and an average of the whole ledge gave 375 oz. The assessment work was completed in October, and after the men had left, the owners of an adjoining claim, the Big Bertha, which had been located three days previous to the Bon Ton, continued work where the Bon Ton people had left off. Working through the winter they drove a tunnel 100 feet on the Bon Ton ledge and sacked the ore that had been previously taken out, as well as what they won themselves, claiming that the ledge was on the Big Bertha. The survey has established that the tunnel is on the Bon Ton and the Crown patent is being applied for.

The Big Bertha had acquired a big reputation and had been bonded for something like $40,000 on the strength of the showing in what was really the Bon Ton ledge. Litigation had commenced, but on Capt. Adams' arrival, a final settlement was amicably made.

Capt. Adams, from Montreal, is one of the Canadians who is investing largely in this district, with full faith in its capabilities and prospects. He and those associated with him (wealthy Boston capitalists), have spent considerable time in the district this summer, and are pushing on their assessment and development work with a view to entering on energetic mining early in the coming year, their object being exclusively to work their properties themselves.

They also have the Chamblet and Britomarte claims in the Mount Adams district (Slocan), where they have eight men at work opening up the claims with a tunnel which is already in about 50 feet. They have a ledge 40 feet wide in places, of good concentrating ore on the Britomarte, while on the Chamblet they have a 3 foot ledge of practically clean galena averaging $1.25 to the ounce of silver per ton. They also own the Landscape claim and other interests in this district. Besides they have the Skylarks Westland and Conundrum, on Kootenay Lake, near Ainsworth, on which the assessment work is to be done this month. They are close to the lake, and their development will be simple and easy.

In the Okonagan country Capt. Adams has eight claims with gold-bearing quartz in the Fairview and Osoyoos districts. Average assays give up to $19.50 in gold, and hand samples have given as much as 289 oz. silver and 11 oz. gold to the ton. He intends making immediate investigations of these properties, and if the results are as favourable as expected, he will prepare to work them next year. The captain, on his return from the Slocan country, is quietly and seriously enthusiastic and says that though there are probably cases where the ore bodies are simply "bunches" and "blow-outs" there are many properties which have been conclusively proved to be continuous and of such an extent as to warrant the claim that the district will be one of the greatest silver producing countries in the world.

The Kootenay and Columbia Prospecting and Mining Company, Ltd., of Ottawa, Ont., has been working the Wellington mine since last August with most satisfactory results. They have had a diamond drill, steam pumps and steam hoist in operation, supplied by steam from a Kelly sectional boiler, and they are now shipping ore to Tacoma. The shipments made by this company from this mine during 1892, showed that the ore was of a very high grade—some of it being the highest shipped from the district, viz., 1,097 oz. silver to the ton, while the average ran 375 oz. The vein is 4 feet wide, 2 feet 6 inches of this being solid ore, galena and grey copper, the other 18 inches being good concentrating ore.

At the present time the ore is being taken from the mine on mule back down a mile and a half trail to their ore house on the waggon road, and from there to Kaslo by waggon. The property is in charge of Mr. Ed. Watts, the company's manager in the district, who has had a lengthened mining experience both in Eastern Canada and in Colorado and the Western States.

In conjunction with a Spokane syndicate the Company is also working the Stanley, which produced 50 tons of ore during June, and are also interested in more than 20 other claims in the Slocan country, on which development is being pushed on rapidly. These properties have lately been visited by Mr. W. A. Allan, of Ottawa, who has expressed himself in the highest terms of praise of the country, and he is confident that it is one of the richest silver-lead districts in the world.

The intention of the Company for this year is to continue their work as at present, opening up and developing their properties until the silver question is more settled, and with the thorough belief in their valuc they already express their intention of pushingon vigourously the mining of the properties early in the coming year.

The C. P. R. offers to ship ore from Kaslo to Swansea at the rate of $27 per ton in carload lots. The present rates from Kaslo are: to Tacoma $9.50, to Helena $7.50, to Great Falls $7.50, to San Francisco $11.50.

The Kaslo sampler commenced work on August 11th, by putting through some five tons of Bon Ton ore, which gave a result of 375 oz. of silver per ton and 43% lead. The sampler has a Blake crusher, a small Gates crusher and a sampling pulverizer, driven by a 25 h.p. engine and portable boiler. It is well built in a sheltered part of Kaslo Bay, with a good wharf, and is easily reached by both water and road. The Company buy the ore, giving 50 per cent. of the assay value in cash on sampling the ore and the rest when the smelter returns are received. This will be a great help to small mine owners and will enable many men to proceed with their work who would otherwise be compelled to stop from want of funds. The management is in the hands of Mr. Clymo, of Montana.

Development work on the Yosemite claim on Liddle Creek (Slocan), has been pushed with very satisfactory results. The ledge has been found to be continuous for at least 1,500 feet and is in places 11 feet wide, 3 feet being clean galena and the rest good concentrating ore. The galena carries over 150 oz. of silver to the ton.

Steam pumps and hoisting gear are being put in place at the Dardanelles by Mr. Rea Cockle. The mines are in charge of Mr. Davenport (one of the owners), who has had a long experience in mining throughout the Western States. There is a group of seven claims, and shipments of ore made from them have averaged as high as $500 to the ton. The ore is galena.

Vancouver Island.

In the report of the Medical Committee of the New Vancouver Coal Co., submitted at the annual meeting of the employees, held last month, the following abstract of financial statement was submitted :—

Receipts.

To Balance brought forward	$ 184 00
Northfield Medical Fund	418 00
Receipts as per monthly pay roll.	10,403 25
Receipts, Special Levies	4,608 00
	$15,613 25

Payments.

By Salary of Surgeon	$ 8,216 10
Northfield Medical Fund	110 00
Ordinary monthly payment for accidents	2,506 00
Special Grants :—	
J. Williams	800 00
W. J. Pollard	500 00
S. Kenyon	500 00
J. Spooner	500 00
W. Arbuckle	500 00
J. A. Macaloney	500 06
W. Richardson	500 00
S. Woodburn	500 00
Printing Rules and Certificates	17 00
Balance—Cash at bank	429 15
In hand	35 00
	$15,613 25

The New Vancouver Coal Company's miners have decided to accept the proposed temporary reduction of 20 per cent. on their wages, other workers to submit likewise to reductions varying in their cases from 10 to 20 per cent. It is consequently expected that the Nanaimo coal output will again advance shortly, mine owners being able to meet reduced offers for their fuel.

The Hamilton Powder Works of Northfield have just forwarded three more carloads of black powder and dynamite to West Kootenay for blasting purposes, making 14 carloads already sent thither this summer. The Powder Works are, this year, having an unusually busy time.

The total quantity of British Columbia coal received at the port of San Francisco from 1st January to 31st July this year, is reported to be 280,910 tons.

Salmon and Pend d'Oreille River Districts.

(From the Tribune).

While column after column has been printed regarding mining operations in the Slocan, but few lines have appeared regarding operations in a district within easy distance of Nelson ; yet there are almost as many men employed in the one as in the other, and the product of the one least known is gold, a metal that appears to be in great demand at present.

From Waneta, at the mouth of Pend d'Oreille river, to the mouth of the south fork of the Salmon river, a distance of thirty miles, nearly all the ground has been taken up by large and small companies, as well as the good ground on several of the smaller tributary creeks. The Kootenay Hydraulic Company has acquired all the bench ground between Waneta and the mouth of Fifteen-mile creek. This company is now engaged putting in a half mile ditch between Sixteen-mile and Fifteen-mile creeks, the work being done by Brewster & Thomas under contract. The ditch from Fifteen-mile creek to Fifteen-mile bar is completed, and sluicing on the bar will be commenced within two weeks. The company's main ditch will be thirteen miles long, and is about half completed. All the small creeks, like Four-mile, Seven-mile, Twelve-mile, Fifteen-mile and Sixteen-mile, are tapped in order to get a supply of water adequate to carry on operations. The company has over sixty men in its employ.

Between Fifteen-mile creek and the mouth of Salmon river, a distance of three miles, are a number of small operators, all at work making ditches. This ground is known to be good as it was worked in the '60's, when everything used was packed in from Walla Walla.

On Salmon river the Bates Company is finishing a 1¼ mile flume at a point about three miles above the mouth of the river. Next above is the Gorkow Company with sixteen men at work on a 1½ mile ditch. This company has its work so well under way that a clean up will be made by the middle of the month. As an indication of the value of the ground, three yards were sluiced and $16 cleaned up. Above Gorkow's the Wilson Company has six men at work whipsawing lumber for a flume. The next above Wilson's is the Downs Company, then comes the Dunning Company. The latter has just started operations. Above Dunning's are the Mizener boys, who are engaged at both placer and quartz mining. They have two placer claims, one on each side of the river. On the east side of the river they are at work on a ledge that carries ore assaying 400 ounces silver and $28 gold to the ton. They also have men prospecting for them on Lost Creek. Mizener's camp is six miles from the mouth of the river.

Above Mizener's, the Fisher, Raife & Long Company has ground on the east side of the river. The Salmon River Hydraulic Company has taken up a claim on Big creek, which empties into Salmon river from the west 2½ miles above Mizener's, and is prospecting the ground. The next above is the Officer Company. At the mouth of the South Fork the Stewart Company has a claim. Quite a number of prospectors are at work on this creek. Five miles above the south fork is a stream called Sheep creek, on which the Spokane Hydraulic Mining Company has a mile and a half of ground.

Altogether, fully 200 men are either at work for these companies or are engaged in prospecting in what is locally known as the Salmon River country, a country that is directly tributary to Nelson. That they are not at work on barren ground is shown by the fact that Mr. Going tested the ground in probably a hundred different spots, and in no pan did he fail to find colors, but, on the contrary, found from five to twenty-five colors of flake and pinhead gold in each pan. Careful estimates give the value of the ground at from eighteen to twenty-five cents a yard, and the cost of working 2½ cents. Capital, however, is required to open up the claims, as ditches alone cost from $1,000 to $1,200 a mile.

Miscellaneous.

The Westminster Slate Company sent up a pile driver in tow of the tug Kildonan to their quarters at Jervis Inlet Monday to assist in the construction of a new wharf at the quarry landing. The Kildonan will bring back a cargo of slate for shipment to different parts of the country.

The lessees of the No. 1 mine at Ainsworth will make a trial shipment of forty tons of ore from that mine to the Tacoma smelter. The ore is of four grades, namely, first-class, carbonates, and high grade and second grade concentrates, ten tons each. The first-class ore should go 200 ounces to the ton, the carbonates 120 ounces, the high-grade concentrates 350 ounces, and the second grade 150 ounces. Some twenty men are kept at work, and if a concentrator was only erected on the property, the mine could be worked to advantage even at the present price of silver. As it is, however, the expenses of hand sorting and jigging makes the total so high that there is little left to the lessees. The ore will go out by way of Bonner's Ferry on the "State of Idaho."

CANADIAN COMPANIES.

Similkameen Gold Gravels Exploration Co. has made application for incorporation under the Companies Act, B.C. Head office: Vancouver, B.C. Authorised capital, $100,000, in shares of $25. Directors, Chas. E. Hope, T. R. Morrow and Henry Barwick. The objects of the company are to purchase mining leases of lands or mining claims in British Columbia, and to carry on the business of hydraulic or any other process of mining, etc.

Bell's Asbestos Co., Ltd.—The following circular has been issued by the secretary of Bell's Asbestos Company, Limited: "I am instructed by my directors to inform you that the volume of business of the Company is fully maintained, but in view of the universal depression of trade, they have decided that it is undesirable to declare an interim dividend."

The Provincial Manganese Mining Co. Ltd.—The organization of this company, which has been formed to take over the property formerly owned and operated by the Tennycape Manganese Company in Hants County, N.S., has been organised as follows: D. C. Fraser, M.P., New Glasgow, president ; George E. Boak, vice-president ; W. F. Jennison, manager ; Lewis W. DeBarres ; and J. P. Burgess, secretary-treasurer. The property contains some 300 acres, and is situated near Walton. Development has been commenced and shipments will be made at an early date.

The New York Freestone Quarrying Co.—Notice is given by W. H. Tuck, in the Official Gazette, N. B. that unless outstanding liabilities of this company are met within three months after publication he will seize its estate for payment thereof. The company at one time did business in the county of Westmoreland, N.B.

Ogema Silver Mine Co., was sold at public sale at Port Arthur, August 15th. The affairs of the company will be wound up, on account of dissension among the stockholders. The mine, which has not been worked for some time, was bought by J. F. Ruttan, of Port Arthur, for $925.

Newfoundland Mineral Syndicate.—Was registered in London on July 21, with a capital of £5,000, in £1 shares, to acquire a certain license to search for minerals, dated June 15, 1892, granted to R. H. Jones, to pay the expenses incurred by this gentleman in searching for asbestos and other minerals ; and to prospect for asbestos and metals of any description. The first directors are : C. W. Bradbeer, H. J. Weston, and H. J. Richards ; qualification, £50 ; remuneration not stated.

LEGAL.

An Interesting Action Against our Old Friend, Mr. D. J. Kennelly.

In the records of the Superior Court, Boston, we find that an action has been entered by Wm. W. Hewitt, attorney-at-law, against D. J. Kennelly, late manager of the Sydney and Louisburg Coal and Railway Co., to recover the sum of $5,150, being unpaid fees for legal services rendered in Boston and New York, in Kennelly's claim for $60,000 against H. M. Whitney *et al*, (of the Dominion Coal Co., Ltd.) The statement of claim shows as follows :—

Fees	$5,000
Retainer	250
	$5,250
By cash on account	100
Balance due	$5,150

Tests of Explosives.

E. Larmoyeux and L. Namur (Annuaire de l' Association des Ingenieurs sortis de l'Ecole de Liege, 5th series, vol. v., pp. 77-120), give the results of an extended series of tests made with various explosives, principally to to determine the influence of temperature and of the length and kind of tamping. The tests were made with several samples of grisoutite, compressed powder, and Favier powder. The tabulated results show the weight of the explosives used, the detonator, and the strength of the explosive as measured by projection and by the lead block. The experiments in the presence of fire-damp and suspended coal dust with these explosives are also tabulated, to show the weight of explosive and detonator, the length of tamping, the amounts of dust and gas present, the temperature and the results. A large number of explosives were also tested by being submitted to a falling weight.

The School of Mines at Madrid.

The Spanish Government has recently devoted much attention to the equipment of a suitable mining school At present the attendance of students is but small. The school itself appears to have an important future before it in view of the well-known mineral richness of the country. F. Toldt in the (Oesterreichische Zeitschrift fur Berg-und Huttenwesen, vol xi., p. 446) describes the course of teaching adopted. The Government devoted £40,000 to the erection of the buildings and to their contents. The course is of three years duration. During the first year the studies include chemistry and assaying, mineralogy, and mechanics ; during the second, geology and palaeontology, civil engineering, and metallurgy ; and during the third year, mining, metallurgy, and electro-technology. The students must pass through the ordinary course at the polytechnic school before entering the School of Mines. Excursions are made by the students as a part of their course of studies, similar to the mining and metallurgical excursions of the students at the the Royal School of Mines in London.

A Chinese Steel Works.—The plant was recently forwarded to China for a Bessemer steel works. It includes two five ton convertors, with the necessary cupolas, blowing engines, cranes, etc. The entire machinery for a large rail mill has also been sent out, as well as that for a plate and bar mill, together with twenty puddling furnaces. Two large blast furnaces of the Cleveland type, with a capacity of about 100 tons a day, are in course of construction on the slope of the Hamyang Hills, opposite to the city of Hankow. The works will cover about twenty acres.

he Choice of Coarse and Fine Crushing Machinery and Progresses of Ore Treatment.

By A. G. Charleton. *

(*Continued from page 126.*)

Mr. T. A. Rickard in a paper read before the American stitute of Mining Engineers, June, 1891, says :†—"The mplete success of the treatment is largely due to the treme friability of the ore, which renders its pulverizan easy, whilst its porosity assists materially in the rough chlorination of the gold." An enthusiastic wri- has spoken of the ore as a sort of snow-drift, which lts in the chlorination vats of the company, into a lden sand, such as might be supposed to have been ught from the bed of the river Poctolus, instead of m the top of an Australian mountain. The extreme hness of the stone hitherto available for treatment in ge quantities (the capacity of the works being 1,800 s per week), the extremely minute state of subdivision the gold, and the physical peculiarities of the ore above erred to, have all tended to make barrel-chlorination plied in this peculiar way a success, where the stamp- ll had been unsuccessful, and this also accounts in no all degree for successful crushing of the ore with rolls. Mr. Rickard remarking on the cause of failure when the e was stamped, says :—"The rock which the battery 5 stamps at Dee Creek) was called upon to crush, aver- ed 10 ounces per ton, but the contents of the tailings oved of much greater value than the amount of amalgam tained. This led to a critical examination of the ore the Sydney Mint." It was found that the bullion was a fineness hitherto unknown in nature, assaying 99·7 r cent., occasionally 99·8 per cent., of pure gold, the t being copper with a trace of iron, It is remarkable being almost entirely free from silver. Dr. Lebius, of e Sydney Mint, considered as a result of numerous ex- riments, that the iron present was in the form of an ide, which coated the gold, and so prevented its con- t with mercury. In a foot note Mr. Rickard adds: My own experience with the ores of Gilpin County, lorado, leads me to believe that this is more frequently e obstacle to successful amalgamation than is usually pposed.

For dealing with free-milling silver ores (carrying less an 6 ounces per ton of white metal) belonging to class 2 a rule one may employ :—

1. Wet stamping, followed by direct amalgamation in pans or barrels. The ores of this class are limited. only embracing decomposed surface-ores, carbonates, and occasional deposits of argentite, chlorides, chlorobromides, and native silver.

For dealing with pyritic ores of gold and silver, belong- g to class 3 which contain the larger proportion of their tallic contents in combination with sulphides. The lowing are the usual methods :—

(*a*) If the sulphides are massive.

1. Hand-picking and after treatment as described below.

(*b*) If the sulphides (pyrites) are disseminated.

2. Wet stamping, combined with battery and plate-amalgamation, to extract the free gold, followed by fine concentration of the pyrites, and treatment of the hand-sorted ore and concentrates by smelting for lead, which yields bullion that has to be refined by different processes ; or by smelting for copper in reverboratory furnaces, to produce an enriched copper matte.‡ The choice of these methods depends on whether lead or copper is the predominating metal. More frequently, however, the gold is extracted from the concentrates by the ordinary Plattner vat-chlorination treatment, whilst in a few special cases an iron matte is produced, and sold to smelters, or crushed and chlorinated.

3. Wet stamping, followed by amalgamation and fine concentration, and grinding the concentrates raw, in pans or Chilian mills.

4. Dry stamping, followed by roasting, with or without salt, and amalgamation in pans or barrels, a process which is only adapted, however, as a rule, to rich silver ores, carrying a certain proportion of sulphides, but not enough to pay for concentration.

5. The new cyanide-lixiviation-process, which is claimed to be applicable to the treatment of certain gold ores, much in the same way as the Russell process is to silver.

6. Ordinary lixiviation.

Dealing with ores belonging to class 4, which are mongst the most difficult to treat, because a process apted to the extraction of gold may be very inefficient r the recovery of silver, and *vice versa:* when one etal is in small proportion as regards value, it is fre- ently sacrificed to the most profitable processes com- ercially for the other. Many of the base silver ores of e United States contain 5 to 15 dwts. of gold, and from to 50 ounces of silver per ton. For such ores, dry amping, roasting, and pan-amalgamation is mostly used, nd under proper conditions will extract 90 per cent. or ore of the silver, but only 40 to 60 per cent. of the gold. ately, however, coarse crushing, instantaneous roasting Stetefeldt furnaces, and double leaching by the new ussel process has come into prominence, and is said to e giving excellent results in certain instances, as regards conomy and extraction of both metals.

The Russel process seems to be more particularly applicable to those ores which do not contain enough lead or copper for smelting, are poor both in gold and silver, and which contain large amounts of sulphur, arsenic, and antimony, since roasting with salt would convert the base metals as well as the silver into chlorides, and would give a very base bullion if it were amalgamated. There is, however, a remedy for this, which Mr. McDermott points out :* "When the silver is in combination with sulphides, antimonides, arsenides, and tellurides of the baser metals, the pan process becomes inefficient and expensive. By contact with iron surfaces, heat, and the addition of some chemicals—chiefly salt and sulphate of copper—a partial decomposition of the complex minerals is effected, and some of the silver amalgamated, but the wear of iron, loss of mercury, cost of power and chemicals, and the production of base bullion together, go far to neutralize the gain made in the recovery of the silver. In such a case a great benefit is derived by combining concentration with amalgamation. The light, flocculent chlorides and sulphides of silver can be amalgamated to a high percentage, while concentration is almost useless to deal with them in the form in which they exist in a free or decomposed ore.

On the other hand, concentration can be made very effective on the undecomposed complex minerals, for which amalgamation is ill-adapted.

There are two methods of combining the processes according to their order, concentrating either before or after the pan treatment. In regard to the relative advantages of the two, concentration before amalgamation is the natural method, because it relieves the pans of the baser minerals, which are a disadvantage in the amalgamation, and the subsequent concentration of which is made more difficult by the grinding or attrition of the minerals in the pans.

The only argument against the universal adoption of this order, rests on the disadvantages of sometimes having native metals, and some chlorides and sulphides entering the concentrations, instead of appearing at once as bullion which they otherwise would do, and also, that very perfect settling of the slimes from the concentration tails is necessary, to prevent loss of the flakey silver chlorides and sulphides. This process is in use at the Standard mill, California.

When the free metal is gold, the first-named disadvantage can be overcome by using copper plates before the concentrators, and this process was adopted by the Montana Company with great success, after first trying pans before the concentrators.

Comparing the combined process with dry crushing and roasting, the advantages of the former consist in a reduction of the cost of working fully one-half of that of dry crushing, a crushing capacity of double for the same number of stamps, a decreased cost of erection, and a higher saving of gold present. Against these advantages may be placed simply the increased percentage of silver saved by the dry process under certain circumstances.

When combined gold and silver ores carry over 10 per cent. of base metals it usually happens that the silver does not exist equally in the minerals present, but is concentrated in one of them as a rich, brittle ore. It follows from this, that concentration in some instances is very ineffective, because while 90 per cent. of the heavy base metals may be saved in the concentrates, the loss of the fine silver-bearing mineral in the slimes may be fully 50 per cent. of the assay value of the crude ore. In some cases the clean concentrated, heavy minerals do not assay more than the original ore from which they were separated.

This is a very strong argument against the injudicious application of fine concentration to all cases, for, as Mr. McDermott says, there are ores of both gold and silver in which the sulphides are so rich, that even a very small loss by weight involves a very large loss by assay of the precious metals.

Such minerals as tellurides of gold and silver, ruby and brittle silver ore, come under this head. In concentrating some of the tellurium ores of Colorado, some of the very finest slime material, overflowing from the concentration tanks of the Frue vanners, assayed as high as £5,000 per ton in gold and silver.

Where there is danger of loss, as described, it is advisable to introduce a double concentration, re-treating the tails on vanners.

For dealing with exceptional ores belonging to class 5 : if their value lies mostly in tellurides of gold and silver, with little or no sulphides present, the most successful method yet found is by selection of the rich ore, and concentration (as above described), by double treatment of the low grade ores. Both rich ore and concentrates, are then so valuable, that smelting on the spot or shipment to smelters is advisable.

Another class of exceptional ores are those in which the gold is not free, so far as tests indicate, and yet there are no sulphides present.

These ores are generally oxidized in character, changed from their original form, and contain chloride of silver in addition to the gold. As some of these ores, when leached with hyposulphite of soda, yield a large portion of the gold as well as the silver, it would seem to indicate that the gold exists as a chloride, combined with the silver, either as a double insoluble chloride, or mechanically protected by the latter from being leached out by the natural drainage water of the mine. Such ores are uncommon, but have been worked to some extent by a raw leaching and concentration for the fine carbonate of lead, and its combined silver which is also present.

There may be other explanations, however, to account for the peculiar character of the ores just alluded to. On page 6 of Gold Amalgamation and Treatment, the losses of gold in milling are referred to five principal causes :—

1. Loss of free gold, quicksilver, or amalgam, due to carelessness or inexperienced amalgamation.
2. Free gold and gold-bearing sulphides, attached to or embedded in particles of rock.
3. Gold contained in base metal sulphides, broadly termed sulphides.
4. Gold lost in fine slimes, and sometimes in solution.
5. A condition of gold in which it is not susceptible of copper-plate amalgamation.

It is with the last of these that we now have to deal.

Quite recently* Mr. Richard Pearce, of Argo, Colorado, has given some most interesting facts with regard to the association of gold with other metals in Colorado, which bear on amalgamation and concentration. His investigations go to prove that gold and silver exist in some of these ores found below the water line, alloyed with bismuth, tellurium, and copper, and perhaps arsenic, where the presence of such combinations has hitherto been unsuspected, and a coarse-grained almost pure pyrites containing silver and a small value of gold, from the Louisville mine of Leadville, has been proved to contain metallic tellurium. When thus combined the gold would appear to be more or less refractory to the ordinary milling treatment, and this may account for some of the troubles set down to so-called rustiness.

A natural crystalline compound of gold and bismuth, has lately been discovered in Australia, it is said, and native alloys of these metals are known under the names of maldonite and bismuthaurite. Hessite, a natural combination of tellurium and silver (Ag_2Te) has been found in some of the Red Cliff veins, and a telluride of bismuth, probably tetradymite was found by Mr. Pearce in ore discovered at Ouray. He contends that, in certain cases, bismuth performs a by-no-means small part, in influencing the general deposition of gold, and also in causing the refractory behaviour of this metal under metallurgical treatment.

Mr. Pearce adds : "The occurrence of gold in this district seems to be intimately associated with that of eruptive porphyries, and the impregnation of veins with gold-bearing minerals is apparently always accompanied with silica. Evidence of intense thermal action† is one of the chief characteristics of gold deposits. Examples of these processes may be found in Gilpin, and also in Boulder County. In the latter district, known as the 'telluride belt,' there are indisputable evidence of vein impregnation by the circulation of siliceous waters through the joints of the porphyry ; in this case tellurium is the chief mineralizing agent of the gold. Perhaps the most striking example of the deposition of gold, through the agency of thermal waters, may be seen in the celebrated Bassick mine, which has so often been described. This deposit exhibits all the characteristics usually accompanying geyser action The disintegration of the porphyry, with a partial replacement of the felspar by silica, is here clearly shown. The gold was combined almost in its entirety with tellurium, and rich tellurides of gold and silver were found sprinkled through the mass of material. In some remarkable specimens these tellurides formed a distinct coating on the surface of smooth boulders which had become rounded by attrition from the action of steam."

Dr. T. Egleston, in an elaborate paper on the causes of rustiness and some of the losses in working gold ores,‡ points out that the term rusty is used by miners to indicate a condition in which the metal is supposed to be coated superficially or alloyed with some substance, which prevents contact with mercury, and consequently precludes the possibility of amalgamation.

Gold in this state, it appears, is frequently covered with a brownish coating, which has a much redder colour than ordinary gold, and is irregularly distributed over its surface, where the least abrasion has occurred the metal underneath show the true gold colour. Fine particles of gold are sometimes visible with the microscope in the detached coating, and it often cracks off from pieces of gold, leaving them bright. Very often this film is composed entirely of silica, deposited on and beside the gold. It is sometimes opaque, and again quite transparent, so that the gold can be seen, with the microscope, disseminated through it, just as cinnabar-crystals are seeen in the red chalcedony of the district around Knoxville, California. There may be, for example, many artificial causes which produce this rustiness of gold, the covering of the surface with particles of some foreign substance, or its alloyage with other metals, as already explained.

As Mr. McDermott remarks, concentration and pan amalgamation would probably be effective on the former class of ores, though for reasons that will presently appear the writer would like to add, or concentration preceded by crushing in centrifugal roller-mills, if other circumstances admit it. Dr. T. Egleston's view is, that the action of rubbing, which occurs in any machine like the arrastra, is much more likely than the stamp-mill to pulverize the fine pyrites, break up any coating that may be

* Transactions of the Federated Institution of Mining Engineers.

† *Trans. Am. Inst. Min. E.*, vol. xx., page 150.

‡ The gold and silver in this matte are frequently extracted by a et process from the copper-bottoms which contain the gold, after e silver has been extracted by the Ziervogel or Augustine processes.

* Gold Amalgamation, by Walter McDermott and P. W. Duffield, page 88.

* The Association of Gold Ores with other Metals in the West.—*Trans. Amer. Inst. Min. E.*, vol. xviii., page 447.

† The idea Mr. Pearce intends to convey (which is the writer's view of the matter) is that the filling of veins with mineral, is rather due in most cases to the leaching of the adjacent rock-masses, followed hy a gradual replacement of the original constituents of the lode with ore, along certain horizons or helts, than to the action of thermal waters, building up masses of mineral in an open fissure, though both solfatara action, as Mr. Pearce remarks, at the Bassick mine, and suhlimation in exceptional instances, may have tended to such a result.

‡ *Trans. Amer. Inst. Min. E.*, vol ix., page 646.

around the particles of gold, rub off the superficial deposit, and thus bring the gold into contact with the mercury and make it amalgamate. He states, as a remarkable fact, that in the early days, Mexicans with the arrastra, got 50 to 60 dollars a day, where stamp-mills, working the same rock, only obtained 15 to 20 dollars, and instances can be cited where, with the best modern machinery, only 20 to 30 dollars can be got out of rock which yields 700 to 800 dollars by fire assay.

Of course this might be due partly to the first cause of loss cited, viz, carelessness or inexperience on the part of the workmen running the mills, but this is on the whole unlikely. Amongst other causes in the treatment and composition of the ores which render gold unamalgamable in the mill, and which have to be considered and guarded against, Dr. Egleston mentions:

1. Gold which has been hammered, so as to increase its density and close its pores, amalgamates very slowly, a condition, however, which can scarcely be taken into account in the working of a stamp-battery, unless the gold is very coarse.

2. The presence of sulphuretted hydrogen in the water, likely to be induced by the presence of soluble sulphides.

3. Gold which has been exposed to the vapour of sulphur, which no doubt accounts for the behaviour of certain ores when submitted to amalgamation after roasting, and the same is doubtless true of arsenic in some instances, judging from Mr. Pearce's conclusions.

4. Certain alloys of gold, like the phosphide, though others like the arsenide and antimonide (produced artificially) are apparently more tractable. To these alloys must now be added the bismuthide, telluride, and cupride.

5. Greasy substances, like powdered natural hydrated silicates of magnesia and alumina, if present in the ore, froth and coat the gold with a slime, preventing the action of the mercury and lubricants, such as oil, getting into the battery box, are fatal to gold amalgamation.

The late Mr. E. N. Riotte once mentioned in the writer's presence a case within his experience, which occurred at a gold mine in one of the Southern States, where they had to abandon the use of dynamite on this account, as owing to the inexperience of the negroes in its use, portions of unexploded cartridges were left in the stone, and affected the battery yield. The result, if the nitro-glycerine had leached out and collected in a corner of the box, would doubtless have been a revelation to them.

6. Unusually soft water, absorbing air or carbonic acid gas, and so tending to form ferric sulphate (when pyrites is present), which is a most active agent in staining the plates.

Glancing back at the processes that have been referred to, it will be seen, that except in dealing with free-milling silver ores and a few special cases, there is considerable latitude given in the choice of a process, not to mention its details.

Its proper selection will depend on considerations of relative cost, as compared with saving or loss of metal, or other valuable products, that the ore contains; and nothing influences both of these in the same way, or either of them more, than the degree to which the crushing of the stone is carried, which is the author's next proposition.

The finer the crushing, and the more the ore is handled or re-handled, by repeating the operation, the greater of course will be the expense; while the more it is handled and the finer it is crushed beyond a point that is absolutely necessary, the greater also will be the loss. To reduce this latter to a minimum, a certain cost must naturally be incurred, though if it go a little too far, the cost is increased and the loss as well.

This happens under various circumstances, viz:—

A. In coarse concentration of the baser metals and of gold and silver ores, or a combination of both (applicable to the latter classes of ore, when the sulphides exceed say 10 to 20 per cent. by weight) to obtain the mineral with a minimum loss from comminution, the ore must be broken up, only just enough to unlock all the mineral it may contain, down to a certain size, and (theoretically) the mineral and barren rock with it should be separated at once. This will leave, however, a certain amount of yet more finely divided mineral in the residues, which require to be re-crushed and re-treated at so much additional cost, to get out the metal that remains in them, less of course a certain percentage of loss involved in this re-treatment.

When coarse combined with fine-concentration is necessary, it may then be considered how far it will pay, to carry theory into practice, and when labour is cheap, the life of the mine assured for a long period, and the ore of considerable value, the German practice may be adopted, of classifying carefully, reducing the ore gradually, and concentrating close; but when labour is dear, the life of the mine uncertain, and the chief object is to secure the largest possible profit in the shortest possible time at a minimum capital outlay, irrespective of a certain unavoidable loss in unrecovered mineral, the Anglo-American method must be adopted of sacrificing saving of mineral, to saving of cost and time, and crush the ore in quantity, to a much greater average degree of fineness, without such careful regard to sizing it.

The latter practice is the one followed in most American and colonial mills, employing fine concentration for gold and silver ores (when the sulphides in the ore do not run over, say, 10 per cent.) To compare these divergent systems roughly as to cost, two different cases one of a European zinc-and-silver lead mine, the other an American lead mine may be taken.

The works in Europe are those of the New Pierrefitte Co., which the writer was commissioned to inspect last summer, and of which he is permitted to give the following particulars:—

They are situated in the Pyrenees in France, and treat on ore containing galena, blende, magnetic iron, and a small amount of copper pyrites.

On an output of 21,449 tons of crude ore last year (averaging 9·33 per cent. of silver lead, and 11 per cent. of zinc) the cost of dressing, covering wages, supplies (including coal for three months of the year, water-power being used for the remainder), renewals of machinery, etc., may be taken at about 3s. 10d. per crude ton, as given below:—

Continental Works.

	Per Crude Ton. Francs.
Labour	2·35
Supplies and repairs	2·43
Total	4·78 = 3s. 10d.

American Works.

	Per Ton. Cents.
Labour	13·4
Supplies	3·5
Repairs	10·0
Coal	9·5
Total	36·4 = 1s. 6¼d

The American case is that of the new dressing works of the St. Joseph Lead Co., at Bonne Terre, Missouri.* The ore is non-argentiferous galena, associated with some iron pyrites, carrying traces of nickel and cobalt. On an output of 224,203 tons of crude ore in 1886-1887, averaging 5·65 per cent. of galena, the cost of dressing for the fiscal year, ending May 1st, covering labour, supplies, repairs, and coal, was (1s. 6¼d.) 36·4 cents, divided as above shown.

It would take too long to explain the differences of treatment in the two mills, suffice it to say, that the system outlined in both, is to crush with rock-breakers and rolls (preceded at Pierrefitte by spalling and cobbing), and then to jig and wash the ore on tables and buddles. The difference mainly is, that in the one case they give attention to sizing, and in the other they do not, though each mill in detail possesses certain peculiarities of its own. Neither can the relative number of workmen, cost of wages, supplies, etc., in detail be compared, as these data in the cost sheet are wanting, in the otherwise excellent paper quoted, from which the particulars of the Missouri mill are taken. In the French works, wages range from 1 fr. (10d.) to 2 fr. (1s. 8d.) for boys, and 2·75 fr. (2s. 2½d.) to 3 fr. (2s. 6d.) per day for the larger number of adult mill hands, and it is noteworthy that in both mills repairs and supplies (excluding coal from the American case) bear nearly the same ratio to one another.

It would appear at first sight that all the advantages lay with the American mill, and no doubt it does in America where labour is dear with the base ores that have to be dealt with in quantity where the works are situated. The case, however, would be entirely different if the American mill were transplanted to the Pyrenees, and set to work the silver ores of that locality, as the loss in the tailings at Bonne Terre is about 2·13 per cent., or 27·4 per cent. of the total amount of lead in the ore. These large losses are due to included mineral in the coarse-sands, and to very finely divided mineral in the very fine slimes, as a large part of the ore requires very fine crushing, owing to the exceedingly minute state of division of a large part of the mineral.

In the Pierrefitte works such losses with argentiferous galena could not be afforded, and though the writer is not in a position to state what they are exactly, they are far less than in Missouri. Moreover, the cost in the Pyrenees, with a larger output from the mine, could be materially reduced, as the works are not run up to their full capacity, and if their general design could be remodelled on the lines of more modern Continental mill-construction, the expense of treatment (if carried out on a similar scale as regards quantity) might, be made to compare more favourably with the price in America without sacrificing mineral, in view of the lower price of labour.

To again quote Prof. Munroe, the losses in the Lake Superior copper mills range, it is said, from 28·5 to 31 per cent., treating mineral much more easily saved than the Bonne Terre galena, whilst the cost of dressing copper at the Atlantic mill in 1885, using steam stamps, is stated to have reached 30·36 cents (1s. 3½d.), divided between labour, 5¾d.; fuel, 7¼d.; supplies, 2½d. These costs were reduced, however, at the Atlantic mine in 1887 to 27·5 cents or 1s. 1¾d. per ton of copper ore treated. Incidentaly, Prof. Munroe states it is cheaper to crush ore* with rolls, arranged as they are in the Bonne Terre works, than the Lake Superior amygdaloid with steam stamps, but this is partly due to the friability of the Missouri ore; what is far more remarkable, however, is that the rolls produce (according to the Professor's statement) quite as large a proportion of slimes as the steam stamps.

Further, it should be noticed that the above instances of the cost of concentration in America are to be looked upon as a good deal below the average (at any rate of smaller mills), and as a general rule, coarse concentration, where rolls are employed for crushing, does not cost far short of 75 cents or 3s. 1½d, per ton, where labour rates are dear.*

The average cost of dressing different classes of ore in France is given by Dr. Foster and Mr. Galloway† (from a statement of Mr. Huet) as:—

	Per Ton. s.	d.
Iron ore	0	2
Coarse-grained galena	5	10
Fine-grained galena	7	10
Manganese ore	7	10
Copper pyrites, or grey copper ore with iron pyrites	9	9½
Coarse galena and blende	9	10
Fine galena and blende	11	10
Copper pyrites, or grey copper ore with galena	13	10
Copper ore, galena and blende	20	4

Though these figures may have been typical and true of French practice at the time they were compiled, the dressing-costs at Pierrefitte would indicate that they are much above the average at the present time; and, as the translators remark, there is always great uncertainty in estimating such working costs in a general way, for there is always uncertainty with reference to the labour required for shifting the stuff about, and principally with reference to the loss in dressing, to which might be added the attention required by different classes of machines when differently grouped.

If the American losses in dressing be compared with those in Germany it will be seen that the advantage rests with the Continental system.

Oberbergrath O. Bilharz, in a paper entitled "Die Neue Central Aufbereitungs-Werkstatte der Grube Himmelfahrt, bei Freiberg i.S.," puts the losses in the tailings of these works, at only 0·01 per cent. silver, *nil* per cent. lead, 10 per cent. sulphur, and 9 per cent. zinc. While the settlings in the final catch-pits‡ carry only 0·01 per cent. silver, 2 per cent. lead, 8 per cent. sulphur, and 6 per cent. zinc.

Quoting the pamphlet referred to, the transcript of an article from *Industries* (in the *New York Mining Journal* of February 20th, 1892) and the writer's personal knowledge, he would like to refer to the Freiberg works more particularly, because he thinks they are illustrative of American principles, so to speak, engrafted upon former German practice, presenting a model of economy in costs, as well as economy in saving of mineral, to an extent which has never been achieved before, an advance which is undoubtedly in the right direction.

The ores which are obtained from the various shafts of the Himmelfahrt mine consist of argentiferous galena and zinc blende, with iron, copper, and arsenical pyrites, while the gangue is partly quartzose, partly sparry, mixed with the country (gneiss).

On account of the variety of the ores of the Freiberg district, the machinery of the dressing-floors is duplicated, so that ore from other mines can be dressed apart in the two sections, into which the mill is divided.

The annual production of the Himmelfahrt mines alone is 45,000 crude tons, of which four-fifths is concentrating ore, coming from what is known as the pyritic-lead formation (kiesige Blei-Formation) the remainder being rich silver ore and high-grade hand-picked galena ore, found mostly in cross-courses, carrying a gangue of brown spar and heavy spar.

These latter ores, representing one-fifth of the total production, are separated dry (hand sorted and dry stamped) and sent direct to the smelting works.

The dressing floors§ are designed to handle 150 tons of pyritic ore per shift of ten hours, each separate section dealing with 75 tons, with an average total consumption of 35 cubic feet of water per minute, the machinery being driven by steam power.

The ore averages 0·15 to 0·20 per cent. silver; and iron pyrites and galena are the predominating minerals. The zinc blende is black, and contains 33 per cent. of iron. The building is arranged in storeys, one above the other, and contains rock-breakers, screens, hand-picking tables, several sets of rolls, wet gravitation stamps, a variety of revolving screens and jigs, hydraulic classifiers, Stieen vanning frames, and other machinery (fully described in the papers referred to) which present many novel features of detail.

The horizontal compound-condensing engine which runs the whole crushing, dressing and electric lighting plant, indicates 105 horse power, and the works employ 44 workmen, with 3 overseers, 1 engine driver, 1 stoker, and 5 fitters, in all 54 men.

The cost of dressing one ton of ore amounts to 10d.

There are only five points which could be charged against the plant taken as a whole:—

1. That the design involves a considerable capital outlay (an objection, which it will be shown later on, is entirely swept away, when it conduces to and results in economy of treatment, provided that the mine warrants it, and that the working capital of a company can stand the necessary call without stinting the development of the mine.)‖

2. That it may be doubted whether efficient roller-mills of the Schranz type, might not advantageously be substituted for the stamps.

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* *Trans. Am. Inst. Min. E.*, vol. xvii., page 659, H. S. Monroe.

* Limestone.

* In exceptional cases the price may run up to 12s. 6d.

† *Lectures on Mining*, by J. Callon, vol. iii., page 134. Translated by C. Le Neve Foster, D.Sc., and W. Galloway.

‡ Only a fractional portion of the crude ore, which is re-treated.

§ The machinery was built and erected by Mr. C. Luhrig, of the firm of Messrs. Luhrig, of Dresden, in accordance with the plans of Mr. O. Billharz, who designed the installation.

‖ As these works are a Government concern, this last consideration may in the present case be dismissed.

3. That, large as may be the reduction in labour as ompared with many other Continental plants of the same capacity, it might be still further lessened, given a better site than the one at Freiberg, which possesses but a moderate fall.†

4. That owing to the nature of the machinery, several skilled machinists, as well as facilities for making repairs on the spot, are very essential for running it properly.

5. That if anything goes wrong with any of its individual parts, the whole plant appears to be brought to a standstill. The writer was reminded of this by the practical illustration of a belt slipping off a pulley whilst he was going through the works two years ago. It is a matter, however, which is capable of remedy.

On the whole the advantages far outweigh any objections that can be urged, and the structural details of the plant, and erection of the machinery exhibit first-class skilled workmanship.

The stock required to be kept on hand in concentration works consists of duplicate parts of the machines, in more or less number, (depending on the distance from a source of supply and the average life of the different pieces in use).

The proposition stated on page 255 holds good.

B. In the fine concentration of sulphides (which generally accompany the precious metals) on belt or other automatic concentrators, which are so frequently used‡ as an adjunct to the stamp battery.

The size to which the stone is reduced under such circumstances influences very largely the chance of loss of mineral and gold, whether included in the coarser part of the tailings, or liberated as fine slime.

The cost of the actual mechanical fine concentration is not a matter of extremely serious consideration in itself, since assuming 18 tons of concentrates saved *per diem* in this way, crushing an ore containing 2½ per cent. of pyrites, the cost of treatment would not exceed 2d. or 3d. per ton, and dealing with much smaller quantities, 6d.; and further it will not vary much whether the ore is stamped coarse or fine, unless it involves a double concentration (that has been alluded to) dealing with rich ores liable to slime. But in order to concentrate in this way the ore must be stamped wet, and what applies to crushing fine with rolls, is also true of stamps. The finer the crushing the more it must cost in time, representing extra labour and a wear and tear, and also fuel, etc.

C. In stamping previous to grinding in pans, if carried too far, there will again be loss in the battery tails, whilst if not carried far enough, it will give the pans unnecessary work to perform, which would be much more cheaply done in the battery.

D. When the concentrates are treated (obtained by coarse or fine concentration or both combined) by such processes as smelting, chlorination, and lixiviation, it will be found that if it involves a preliminary roasting (as these processes generally do), if the ore is crushed very fine, and it carries much lead for instance, it entails a more careful regulation of the temperature, and unless a suitable type of furnace is used, with extensive dust chambers attached, great losses both mechanically and by volatilization may be incurred. On the other hand, if the ore is not crushed fine enough, and it is subjected to a chloridizing roasting with salt, the chlorination will not be as high as it should be, and the subsequent treatment will be proportionately affected by it.

E. If the ore is to be lixiviated or chlorinated, and the stone is crushed too fine, and at the same time of too uniform a grade, great loss of time and imperfect filtration and leaching will result, more especially if it is at all of a clayey nature.

The choice of a process, whether for treating crude ore or concentrates, must be governed by the relative commercial profits it promises, as compared with other methods of treatment. But before attempting to touch this question, it will be advisable to state certain general facts (under separate headings), giving an outline of several of the processes, which are later on compared, under the head of rival methods of ore treatment, in order to sim lify the subject.

Roasting and Chlorination.

This is, ordinarily the best process to employ, for the treatment of the high grade pyritic concentrates of stamp mills, and hand picked sulphide ores, provided a sufficient quantity can be commanded to run the works full time or nearly so; intermittent work being bad for plant as well as for men. The ore should be kept moist after concentration, till it goes to the drying floors, as otherwise lumps will form which will not roast properly unless re-crushed.

The ore to be roasted is generally worked in reverberatory furnaces to expel the sulphur, arsenic, and other volatile compounds till it is dead sweet or as nearly so as possible. Then a small quantity of common salt is added, and the silver is chloridized, the sulphur is all driven off, and the ferrous and cuprous sulphates are oxidized.

The ore having been damped to about 6 per cent. is gassed with chlorine, a trichloride of gold being formed, which is leached out and precipitated with a solution of sulphate of iron. This gold is collected on filters, thoroughly washed, dried, and melted, and should average from 998 to 999½ fine.

When silver is present in sufficient quantity to justify the extra treatment, it can be recovered by re-leaching the residues with hyposulphite of soda or lime to dissolve the chloride of silver, which is precipitated from the lixivium by the addition of a solution of polysulphide of sodium or calcium, and the sulphide of silver resulting (collected on the filters) is washed, dried and reduced to the metallic state.

There is, however, one point to be guarded against in adopting this latter mode of treatment in dealing with ores, in which the percentage of gold is high, and about equal to the silver.

Kustel* remarks: "If such an ore should be subjected to chloridizing roasting, then impregnated with chlorine gas, leached with water for the purpose of extracting the gold, and finally leached with hyposulphite of lime for precipitating the silver, it would in this case, although a high percentage of silver might be extracted, result in a yield of gold that would hardly amount to 50 per cent., more or less. The reason is not easily explained. The gold may be influenced somehow by the base metal chlorides during the roasting, which prevents the gold being attacked by the chlorine gas."

On the other hand, if the base metal chlorides and the chlorides of silver are extracted previous to the impregnation with chlorine, both metals, silver and gold, can be got out very close by a process invented and patented by O. Hofmann, which Kustel fully describes in detail.

The gold and silver bearing sulphides of the Colorado No. 2, G. and S. M. Co., at Monitor, Alpine County, California (as an instance) were successfully treated by this method.

Should the sulphides contain any lead, it is advisable to conduct the liquor from the leaching vats to settling or storage-tanks, and about 40 lbs. of sulphuric acid (66 degs. B) is added. By this addition the lead is precipitated as sulphate, and the liquor, being freed from lead, can yield no plumbic sulphate with the gold, as it would otherwise do, when precipitated with sulphate of iron; hence a cleaner bullion.

In some chlorination works,† as the sulphate of lead obtained from the base tanks, always contains some gold, it is collected and sold, and a considerable sum is then realized for both lead and gold. The wooden tanks are protected from the action of the acids, by a coating of paraffin paint, and the covers of the chlorination vats are luted on with a mixture of tailings, bran and water.

There are certain pyritic ores, however, to which chlorination is unsuited. These include amongst others:

1. Ores of low grade, which run below, say £3 to £4 value per ton.
2. Those in which the gold is very coarse.
3. Those in which there is any mineral present, or other metal except silver and gold, in the gangue, liable to be attacked and rendered soluble by the chlorine, whilst gold must be either in a metallic state, or in a combination which can be destroyed by roasting without loss.

The impurities most to be avoided are sulphur, antimony and arsenic, since soluble salts of the base metals may precipitate the gold in the leaching vat; hence the necessity of what is termed a dead sweet roast before mentioned. Lead, lime and magnesia are also deleterious, as they are attacked by the chlorine, and waste a great deal of it, besides introducing difficulties in the after precipitation.

Mr. Nelson E. Ferry, M.E., in the New York *Engineering and Mining Journal* of November 28th, 1885, recommended the addition of molasses to the leach when lime was present. Mr. Ferry says: Dissolve one gallon of molasses in 30 or 40 gallons of water and keep for use. The quantity to use in each case must be determined by a laboratory test. If calcium sulphate comes down, either the molasses is in insufficient quantity, or it has not been thoroughly mixed. Examine by transmitted light. Avoid large excess of ferrous sulphate. If the gold comes down at first in a flocculent state, that does not matter, it soon assumes the usual form. The best results are got when the liquid is made slightly acid.

Mr. A. H. Aaron‡ recommends the use of precipitated copper sulphide as a precipitant,§ stirring it into the gold solution, or better, allowing the gold solution to flow through a series of small filters containing the sulphides. He states as a reason, that unless there is copper present to precipitate it, there is often a considerable loss from gold in suspension, due to imperfect settling.

The presence of galena, necessitates a good roasting with a strong finishing heat, as far as its fusibility will allow. This involves the use of a long hearth to raise the temperature gradually, as the charge progresses from one end of the furnace to the other. The roasted ore must be examined to see that no galena is left undecomposed

Any soluble iron chloride or other soluble metallic salt formed, will react on the iron oxide and precipitate the gold, when dissolved, leaving it in the tails of the ore tanks after lixiviation. The addition of a little salt towards the close of the roasting, after the ore has been carefully oxidised, tends to counteract the effect of the lime and magnesia so often present in gold and silver bearing rocks.

Concentrates frequently contain iron as well as copper pyrites, galena, and arsenical pyrites, combinations which do not prevent the application of the process, unless the base metals, more particularly lead (but always excepting iron), are present in large proportions. Losses are likely to occur through the gold being volatilized or affected in roasting, which is more particularly to be guarded against if copper is present, and the ore be roasted with common salt. Much has been written on this subject, and in fact, enormous losses may occur in the chloridizing roasting of gold ores through volatilization of the gold.*

Mr. Kustel, page 57, records the loss of 20 per cent. of the gold contents in the oxidizing-roasting of certain tellurides of gold and silver, and states it is not a mechanical loss, but is due to volatilization. Though with most ores no loss of gold is suffered in this way during oxidizing-roasting, either with iron or arsenical pyrites, loss may occur if the operation be carried on so rapidly that fine particles are carried off by the draught.

A loss of silver in oxidizing-roasting is unavoidable. Plattner† concludes that the percentage increases with the temperature of roasting, and with the looseness or porosity of the roasting charge, that is with the facility with which the air can come into contact with the silver, and the freedom of the silver from combination with other substances. The loss increases also with the time of roasting. He concludes that silver is volatilized as oxide, which decomposes at a lower temperature into silver and oxygen, but Dr. Percy throws doubt on this theory.

In roasting, it is easy to incur an enormous loss of gold by inattention to what may appear insignificant trifles, showing how necessary in such matters is a systematic weighing and sampling, as well as assaying of the ores and products, in order to know at once when such losses are taking place, so as to be able to check them in time. Haphazard and occasional sampling and assaying, are worse than useless; they lead to great losses of valuable capital, frequently to the total abandonment of good properties, and worse than all to a false sense of self-satisfaction, which discourages investigation and improvement by denying the necessity thereof.

If the gold in the ore is of low fineness or combined with silver, a large part of it may be lost in roasting from a different cause, as the sub-chloride will surround the particles of gold, and prevent any further action of the chlorine upon it, in which case the double process, previously alluded to, must be employed.

The quantity of common salt used in chloridizing-roasting, and the time when it can best be added, are of much importance to the final result; and they have to be determined by trial, with different ores. The chlorine must be purified from everything that would be likely to cause a reaction between it and the other constituents of the ore.

Other important factors in the general success of the process are:—

1. Close and clean concentration.
2. Amalgamation of any coarse gold, preceding or following the chlorination.
3. Lixiviation of the silver before or after gassing.
4. Absence of any organic matter in the charge, or wash-water.
5. That the ore is crushed properly. A series of experiments should be made to ascertain how coarse the ore should be to give the best results with reference to economy, large capacity, and best extraction. The pulp for the best leaching must be in a granular condition, and carry as small a percentage of dust and slimes as possible. Mr. John E. Rothwell, (New York *Mining Journal* of February 7th, 1891) points out that for this purpose rolls, properly managed, are best adapted for this purpose. The chief point is to make the reduction in the size of the particles passed through them gradual. The ore should come to the coarse rolls not larger than ¾ inch, and these rolls should crush to about ⅜ inch. The middle rolls are set about $\frac{3}{16}$ inch or less apart, and the fine rolls about as far apart as the size to which the ore must be crushed. If only two sets of rolls are used, the coarse are set a little closer, and the fine remain the same. The springs should be tight enough in tension, not to give with the hardest ore passing through them, but lax enough to allow a piece of steel or iron to pass through without throwing off the belts. The periphery speed of the rolls should be the same or a little faster than the falling speed of the ore, and the ore should be fed in an even sheet across the surface of the roll. This will keep the surfaces true and produce a granular pulp but carrying a small percentage of dust. A still more gradual reduction can be made by making the rolls of larger diameter and narrower, which will give them also proportionately a greater capacity. Rolls of 39·5 inches diameter and 12 to 15 inches face have been used by Mr. Rothwell with good results.

Dr. T. Egleston writing on the formation of gold nuggets and placer deposits says: "I have known of gold (Grass Valley, California) being thrown down on the filter of a Plattner vat by the organic matter contained in the very impure wash-water used for the solution of the gold, rendered soluble by the action of the chlorine. The filter was full of metallic gold, and there was no means of ascertaining how much had been lost. Several ounces of a brown deposit were taken from it, almost pure gold."

† Owing no doubt to its being the only site available on account of other reasons.

‡ Before adding concentrators of this kind to a mill, it is of course necessary to ascertain that the clean concentrates will assay enough to leave a profit on further local treatment, or shipment, to extract the gold, silver, or other metals they may contain.

* Roasting of Gold and Silver Ores, by G. Kustel, second edition, page 123.

† Eighth Report of the California State Mineralogist, page 47.

‡ Notes on the Hydro-metallurgy of Gold.

§ Mr. Claude Vautin, whilst admitting that precipitated copper sulphide (CuS) is a good precipitant in the laboratory, points out that in consequence of its physical condition, and the facility with which it is oxidized to $CuSO_4$, its application in practice is not to be recommended. He recommends fused sub-sulphide of copper (Cu_2S) as a perfect and rapid means of recovering the gold. To facilitate the filtration the Cu_2S is crushed to pass a 60 mesh sieve, and the portion which remains on a 100 mesh sieve only is used; this gives the desiderata of a dry, hard, and granular filter-bed, three points of importance. Whilst charcoal is not free from objections, on account of the large quantity necessary to ensure a complete decomposition of the solution, and the somewhat tedious and troublesome operation of "burning-off" the excess of carbon before smelting the residues, Mr. Vautin claims for this method the advantage that it is not necessarry to expel by heat or otherwise any excess of free chlorine from the solution before passing it through the reagent; nor does the presence of any free hydrochloric acid in any way interfere with the reaction. Any copper, calcium, zinc, etc., also passes through, presenting advantages over the use of hydrogen sulphide or ferrous sulphate.

* Losses in Roasting Gold Ores and the Volatility of Gold—*Trans. Amer. Inst. Min. E.*, vol. xvii., page 3.

† *Metallurgische Rostprozesse*, Freib, 1856.

An excess of chlorine must be present in the generator, and the ore must be washed and filtered thoroughly, otherwise the tub tails will assay 4 to 5 dollars instead of 75 cents.*

LIXIVIATION.

The MacArthur-Forrest Process for Gold Ores.

This process claims† to extract the gold from pyritic ores, without the necessity of roasting; and in certain cases it may have a considerable field of usefulness. When, for instance, the gold is in an extremely fine state of division, and the ore contains silver as well as gold, the fairly high percentage extracted of each metal may render this method a very desirable one.

For plain gold ores, in which the gold is in fine particles, the barrel-chlorination process seems, however, to give a higher extraction, and with ores of moderate and high grade appears to work to better advantage.

It would appear, in fact, that the limitations of the cyanide process might be summed up as follows:—

1. That it is only entirely successful with free milling ores, as although it will deal with pyritic ore, it does so at a greatly enhanced cost.

2. That it is inapplicable to ores containing a considerable percentage of coarse gold.

3. That it cannot be economically applied to rich material, as a loss of 2 dwts. in 8 dwts. ore is a very different matter to a loss of say 2 ozs. in 8 ozs. ore.

4. That it is not applicable to ores containing certain metal and mineral combinations.

On the other hand, it appears to be a process admirably adapted for saving gold in the condition of float, *i.e.*, in an extremely minute state of sub-division, which cannot be caught by any process of concentration or amalgamation.

Briefly outlined, the MacArthur-Forrest process originally consisted in pulverizing the ore to 40 or 60 mesh size, and then mixing, and agitating it, with a solution of cyanide of potassium (the ordinary standard strength of which was intended to be 1⅛ parts of cyanide to 100 parts of water by weight).‡

After a sufficient time has elapsed for the solution of the precious metals, the leach is transferred to large wooden filter tanks, the solutions are allowed to settle, and are drawn off (sometimes assisted by pressure or suction), and the gold and silver contained in these solutions as cyanides, are decomposed and precipitated in a metallic condition, by passing the filtrate through metallic zinc turnings. In the course of this treatment the zinc replaces the gold in solution as cyanide of zinc, which dissolves in the water, while the gold is deposited as a dark powder. This is separated by sieving from the undecomposed zinc, when it is found, by testing with chloride of tin, that the whole of the gold has been precipitated from the leach liquor.

The zinc residues are then removed and dissolved in nitric acid, the gold remaining undissolved as a dark brown powder, which is washed, dried, and melted, yielding almost pure gold.

If there is any silver present it is dissolved with the zinc, and can be recovered by adding a solution of common salt, which throws it down as chloride. It has then to be reduced to the metallic state by contact with sheet-iron or zinc, after which it is washed, dried and melted.

The chemistry of the process§ is simple, depending on the affinity of cyanogen for gold and silver, and the ease with which these metals form soluble double cyanides with the alkali metals. The relative affinities of the different metals, according to Mr. Wm. Jones, stand as follows: 1st, gold; 2nd, silver; 3rd, copper; 4th, zinc, lead, arsenic, antimony, etc.

The solvent action on the base-metals can be reduced to a minimum by reducing the strength of the solutions, the readily soluble gold and silver being dissolved out with only traces of copper, zinc, etc.

The best strengths of solutions to use in leaching out the gold from refractory stone depends entirely on the nature of each ore, and it is impossible to lay down any hard-and-fast line. The point must be determined by practical tests.

Filtration of the liquor is accelerated by using a vacuum, and there is no practical difficulty about this, unless there is a large percentage of clayey matter present. The amount of free cyanide in the liquors, after passing through the zinc, is then determined by means of a standard solution of nitrate of silver, and the liquor is thereafter made up to its original strength and used over again.

To extract the gold from refractory ores a number of points must, however, be observed. If the ore betrays a noted acidity, due to the presence of basic sulphates of iron, etc., (especially marked in the case of disintegrated and weathered sulphides), it should be neutralized with an equivalent quantity of caustic lime in the form of milk of lime. The exact amount of acidity can be determined by shaking up a weighed sample of the ore with water, and adding standard-normal or tenth normal caustic soda solution till the point of alkalinity is attained, as indicated by litmus or any other suitable tests. The amount of lime is then easily calculated. Some ores show as much as 4 per cent. of acidity in terms of soda, and such ores, on treatment with cyanide solutions without previous treatment with lime, fail to yield their gold contents, whereas when previously treated with lime, the greater part of the gold is easily extracted.

Nearly all sulphides show more or less acidity, but when it is under 0·10 per cent. it may for practical purposes be neglected.

The cyanide solution used should be as free from caustic alkali (NaHO or KHO) as possible, as it is apt to form a sulphide of sodium or potassium with the sulphur of the ores, and thus prevent the gold and silver going into solution. This difficulty, when it does occur, is got over by adding calcium chloride.

The cyanide solutions are best preserved from too great exposure to the air, as a part of the cyanide is apt to be converted by oxidation into the cyanate.

From a chemical point of view it appears that the economic success of the process, will mainly turn on the price, and consumption of chemicals, and on the time taken in treating large quantities, to extract a given percentage of gold from various combinations of ores in different localities in which the gold exists in a coarse or fine state of division, and in different alloyage, and in which the pyrites is more or less highly concentrated. The ores of the Witwatersrandt seem specially adapted for treatment by this process.

The Russel Process for Silver Ores.

Quoting Mr. C. A. Stetefeldt, on the lixiviation of silver ores, Mr. E. H. Russel, it is said, discovered that a solution of a double salt of cuprous hyposulphite and sodium hyposulphite (formed by mixing sodium hyposulphite with copper sulphate), exert a most energetic dissolving and decomposing action upon metallic silver, silver sulphide, silver minerals belonging to the group of antimonial and arsenical sulphides, and other silver combinations. Hence, if a charge of roasted ore is first lixiviated with ordinary sodium hyposulphite solution to dissolve the silver chloride, and subsequently with cuprous hyposulphite (this solvent is called the extra solution) an additional amount of silver is extracted, which would have been lost in the tailings, by working according to the old method alone. Or, if the roasted ore contain caustic lime and be treated with the extra solution, the deleterious influence of the caustic lime is thereby neutralized. In the same way the extra solution may be applied to extract silver from raw ores without previous chloridizing-roasting, or to lixiviate ores after they have been subjected to an oxidizing-roasting. Mr. Russel also discovered that lead can be completely separated from a sodium hyposulphite solution, as lead carbonate, by sodium carbonate, without precipitating copper or silver.

After decanting the solution from the lead carbonate, silver and copper are obtained from it in the usual way. This method of separating lead prohibits the use of calcium polysulphide as a precipitant for the sulphides, because calcium, entering the regenerated lixiviation solutions, would also be precipitated as a carbonate with the lead, by sodium carbonate; hence sodium sulphide must be employed. A full investigation has demonstrated that this is by no means detrimental, as sodium sulphide and sodium hyposulphite are more advantageously used in the lixiviation process than the corresponding calcium salts.

Finally, Mr. Russel found that if a hyposulphite solution has a caustic re-action, produced by caustic soda or lime, its solvent power for silver is materially deteriorated. This defect he corrects by neutralizing such a solution with sulphuric acid.

The Van Pattern Process (Ordinary Lixiviation.)

This process consists in: (1) Crushing the ore (generally with rolls). (2) Drying the ore. (3) Roasting with salt. (4) Leaching out the base metals with hot or cold water.* (5) Leaching out the silver with hyposulphite of soda. (6) Precipitating the silver. (7) Roasting the sulphide of silver and melting the bullion.

It is capable of saving about 85 per cent. of the silver in the chloridized ore, assuming it to be suited to this class of treatment.

(To be continued.)

Incline Truck Drop for Calcining Kilns.—A new incline truck drop for use in connection with calcining kilns is described by Mr. C. Wood, in a paper read before the Cleveland Institution of Engineers. This drop was designed for lowering the trucks from the top of the kilns at the Tees Ironworks, where the space was very limited, and for that reason a drop of the ordinary design was not admissable. After a description of the form of drop usually employed in the district, the details of the latter design are given. Four columns support girders, on which is mounted a shaft with four rope pulleys and a brake-sheave. The counter-balance weights work inside the two main columns. These stand on one side of the centre line of the kilns, from which the truck is run on to the lowering table, its weight being so placed as to keep the guide wheels in position. The table at the bottom of its travel is tilted automatically, and the stops withdrawn so as to discharge the trucks on the same side as that on which they were received.

On the Nickel Ores of Canada.

[Translated from the French of M. David Leval, Mining Engineer, Paris. France. Annalles des Mines, 9th Ser., Vol. 1, 1892.]

Location.—The first notice of the occurrence of nickel deposits in the Province of Ontario dates back to 1846,* but no one ever dreamed of extracting the metal or of utilizing its ores until the building of the Canadian Pacific Railway. There is a map published by the Canadian Pacific Railway Co. which points out the exact location of this district and the various railway lines in connection therewith. The most important place in this whole region along the belt of country lying between Lakes Huron and Nipissing, is Sudbury, a station on the C.P.R. and Algoma Branch R.R.

The country is covered over with dense forests partially devastated by fires, but which make the country no less easy of access and investigation to the mining inspector. Streams flow in abundance in the valley during a portion of the year only, for in winter everything is clad with a mantle of snow, for the climate is rigorous.

Mode of Occurrence.—Nickel is here found associated with the magnetic iron pyrites along with copper, in the shape of chalcopyrite. These very mines were first of all worked for copper.

The ore occurs in large lenticular accumulations, interstratified between bands of gneiss belonging to the primary system of North America.

This system consists of two subdivisions. The Laurentian, chiefly gneisses, and the Huronian, formed by green hornblendic rocks and talc schists. The gneisses of the Sudbury region are noteworthy on account of their enormous development to a breadth of more than 1,000 metres (metre equals 39⅜ inches), and by the phenomena of metamorphism which they indicate. There occur, notably granwackes and quartzites, various kinds of diorites, hornblende schists, mica schists, diabases, argillaceous grits, and the whole series associated with volcanic breccias.† The Huronian of Sudbury is above all represented by the red quartzose syenite.

The entire formation has suffered numerous crumplings and foldings, so that it presents a strong inclination or dip amounting to 70 degrees at times. The general axis of up-lift in these rocks is north-east and south-west, but the numerous faults and foldings which affect the formation cause modification of structure in different places.

An important note regarding the deposits in question is their intimate connection with the intrusive diorites which penetrate and cross the gneisses and granwackes. It is at the contact of the diorite masses or near them that the magnetic iron pyrites outcrops occur. These sometimes penetrate the diorites. This diorite furthermore assumes various grades and appearances according to the predominance of the quartz feldspar and hornblende which constitute its mass. Diorite forms the gangue of the ores, a fact which is favorable to their treatment by the fusion process, this rock being relatively but slightly quartzose is preferable to the purely quartzose gangues which generally accompany similar deposits.

Method of Extraction.—The extraction of the Sudbury ores is in the hands of a number of different companies with effective and perfected means at their disposal. Only those mines in the immediate vicinity of the railroad are worked at present, but there is a large number of similar deposits unexplored, unknown or insufficiently recognized owing to the roughness of the district. Nevertheless, from official report addressed to the Secretary of the Navy of the United States in October, 1890,‡ there was then a cubic mass of ore of over 650 millions of tons in the various mines, and the total output of ore up to that date, for a period of two years, was about 160,000 tons. These figures suffice to indicate the economic and industrial importance of Canada in so far as the production of nickel is concerned.

Composition and Average Yield of the Ores.—The average or mean composition of the ores scarcely goes beyond 3 or 4 per cent. of nickel and about the same quantity of copper. The ores of the "Canadian Copper Company" appear to be relatively less rich in nickel than those of the "Dominion Mineral Company." They all appear to become richer in useful metals as the shafts are sunk in the process of extracting the ores.

The following is a sample of the composition of an average ore, chosen as an ore of copper:—

Sulphur	26.717 p.c.	
Copper	12.610 "	
Iron	29.220 "	
Nickel	3.120 "	
Protoxyde of Iron	6.22	Gangue, 29.36 p. c.
Lime	4.84	
Magnesia	2.61	
Alumina	2.63	
Silica	13.06	

Then follow a series of notes giving the results of explorations and mining operations carried on by Mr. E. D. Peters, and prepared by him—"Transactions of the American Institute of Mining Engineers." The paper is called "The Sudbury Ore Deposits," and has already been noticed by the CANADIAN MINING REVIEW at the time it appeared. The other work of reference quoted is a report by M. J. Garnier, published in the "Memoires de la Société des Ingenieurs civils, Mars, 1891," and en-

* Phillips, *Trans. Am. Inst. Min. E.*, vol. xvii., page 313.

† Memoranda on the Treatment of Refractory Gold Ores by the MacArthur-Forrest Process.—Wm. Hodge & Co., Glasgow.

‡ In actual practice, however, these ideas have been modified, and what is known as the percolation system has come into almost universal use, employing standard solutions of a certain strength, first leaching the ore for 6 to 12 hours with 6 to 8 per cent. solution, and for 8 to 10 hours more with a weaker liquor, containing 2 to 4 per cent. of cyanide.

§ The MacArthur-Forrest Process for the Treatment of Refractory Gold Ores.—*Eng. and Min. Jour.*, New York, 1889, vol. xlviii., page 544.

* The base metal chlorides in the water may carry off 0·5 to 3 per cent. of silver, but this can be recovered by simple dilution, unless chlorides of lead and antimony be present (which are likewise precipitated), in which case either the ore must be leached from below, under slight pressure, or the silver must be precipitated in troughs outside the tubs.

* Dr. T. Sterry Hunt, in his "Report to the Canadian Government."

† Dr. Bell. Bulletin Geol. Soc. America.

‡ Sudbury nickel deposits, reports by experts to the U. S. Government, 1890.

titled: "Mines de nickel, auvre et platine du district de Sudbury (Canada)."

This elaborate report then describes in detail the methods of extraction at the "Creighton," "Stobie" and other mines, and the valuable deposits of the "Copper Cliff" mine, the "Evans" and "Blezard," which contain from 3 to 5 per cent. of nickel and about the same quantity of copper.

The writer notes the cost of work and considers the wages of $1.50 to $2.50 per day as dear and the hands scarce, thereby necessitating the company to house and board their staff of miners in order to practice economy.

Cost of Extraction.—By the time the ore has reached the roasting heaps the average cost per ton is $2, along with a proportion of poor ore, brought out above ground of 50 p.c. grade.

Roasting.—Roasting is carried on exclusively in heaps. Upon the good behaviour of this operation depends the success of fusion. Therefore it follows that a great deal depends upon the construction of the heap, and much care is exercised therein. Roasting is given out by contract at 20 cents a ton for heaping and roasting, and 30 cents a ton for taking and brought to the smelter, making in all 50 cents a ton. The companies furnish the tools and wood necessary for the roasting process, which makes the total average cost per ton of about 60 cents. The wood used is pine, abundant throughout the region and costing about 50 cents a cord brought to the works.

The grounds for roasting cover a considerable area, and the fumes which emanate from the heaps destroy the vegetation all around. There is little or no arable soil there. The present accommodations enable the companies to roast 500,000 tons of ore, which take from 50 to 60 days for a heap of from 500 to 600 tons, the dimensions of the heap being about 100 ft. long and 20 ft. wide.

Fusion of the Roasted Ores.—The fusion of roasted ores is the most interesting operation and treatment of the Canadian ores. It is effected in large water jackets of steel sheeting of 3 millimetres in thickness, elliptical in form and all one piece from the crucible up to the supply door. The bottom of the oven is closed by means of a cast iron plate lined with refractory bricks; the scoriæ and matte are drawn or flow out together in a fore crucible, with cool sides, borne on a truck to facilitate its removal. A low dome of steel plate lined inside with bricks carries the fumes into the condensing chamber of the powders and thence to the chimney. On the opposite side is the lateral supply door to let in the fusion bed and coke.

The Constitution of Nickeliferous Pyrrhotite.

By Dr. S. H. Emmens, Youngwood, Pa.

It is the custom of mineralogists to speak of many mineral varieties as formed by one metal "replacing" another to a greater or less extent in certain chemical combinations. This is, I think I may say, the invariable account given in the text books respecting nickeliferous pyrrhotite, a mineral described as consisting of an iron sulphide in which "part of the iron is replaced by nickel." The object of the present paper is to enquire whether the account in question is a correct representation of the facts of the case, or whether the constitution of nickeliferous pyrrhotite differs from the description given in the text books.

The general formula of pyrrhotite is $Fe_n\ S_{n+1}$. This is sometimes written n (Fe S). $Fe\ S_2$ or n (Fe S). Fe_9S_{10}; though probably, for reasons analogous to those recently set forth (Journal of Analytical and Applied Chemistry, Vol. VI., No. 10, October, 1892), the more correct view is to regard the typical compound, Fe_3S_4 as being a homogeneous body, and not as being composed of a mixture of sulphides. This question, however, is comparatively unimportant in the present discussion; as, whatever may be the precise arrangement of the molecules, their number will not be changed, and pyrrhotite will still be defined as an iron sulphide composed of n molecules of Fe and $n+1$ molecules of S. And, on the "replacement" theory, nickeliferous pyrrhotite will be a sulphide composed of x molecules of Ni, $n-x$ molecules of Fe and $n+1$ molecules of S. Let us test this numerical theory by the actual results of analysis.

At p. 74 of the 6th edition of Dana's *Mineralogy* is a table of analyses of various specimens of pyrrhotite. From this I will select the following for discussion, namely:

		S.	Fe.	Ni.
No. 14.	Brewster, N. Y.	37.98	61.84	0.25 = 100.07
" 15.	Putnam Co., N.Y.	39.28	60.03	0.78 = 100.09
" 15a.	" "	38.99	60.04	1.02 = 100.05
" 15b.	" "	39.85	58.73	1.53 = 100.11
" 20.	Frigido	39.65	58.18	2.17 = 100.
" 18.	Hilsen	40.27	56.57	3.16 = 100.
" 17.	Sudbury	38.91	56.39	4.66 = 99.96
" 19.	Gap Mine, Pa.	38.59	55.82	5.59 = 100.

Now it is obvious that any replacement of iron by nickel must take place by whole molecules weighing respectively 58.6 for Ni and 55.9 for Fe. Hence for every Ni molecule in mineral No. 14 of the above list there must be $\frac{58.6}{.25} \times \frac{61.84}{55.9} = 259.3$ molecules of Fe; and, in like manner, there must also be $\frac{58.6}{.25} \times \frac{37.98}{32} = 278.2$ molecules of S; or, in view of the analytical total being a little in excess of 100, we may regard the mineral as consisting of Ni $Fe_{259}\ S_{278}$ instead of Ni $Fe_{259}\ S_{261}$, as called for by the pyrrhotite theory.

Similar calculations in the other cases give the following results:

No. 15.	Ni	Fe 80.68	S 92.22	showing an excess of S	9.54
" 15a.	Ni	Fe 61.71	S 70.00	" " S	6.29
" 15b.	Ni	Fe 40.24	S 47.69	" " S	5.45
" 20.	Ni	Fe 28.11	S 33.46	" " S	3.35
" 18.	Ni	Fe 18.77	S 23.34	" " S	2.57
" 17.	Ni	Fe 12.685	S 15.29	" " S	0.605
" 19.	Ni	Fe 10.468	S 12.642	" " S	0.174

In none of these minerals does the formula $(Fe\ Ni)_n\ S_{n+1}$ hold good; and we therefore have reasonable ground for declaring that the constitution of nickeliferous pyrrhotite is *not* represented by this time honored but somewhat superficial generalization.

It will be noticed that the excess of sulphur bears some relation to the percentage of nickel; the lower the nickel contents the greater being the surplus of sulphur, and *vice versa*. This necessarily follows from the great size of the compound molecule when the percentage of nickel is small. If, however, we investigate the proportion borne by the sulphur to the total metal, we shall find a tendency to constancy rather than to variation, as is shown in the following table:—

Per Centage of Nickel.	Proportion of S Molecules in Excess of $n+1$ to		
	Ni Molecules.	Fe Molecules.	Ni+Fe Molecules.
0.25	16.9	.0652	.0649
0.78	9.54	1182	.1168
1.02	6.29	.1019	.1003
1.53	5.45	.1354	.1322
2.17	3.35	.1192	.1151
3.16	2.57	.1369	.1300
4.66	0.605	.0477	.04421
5.59	0.174	.0166	.01517

This suggests that the constitution of nickeliferous pyrrhotite is polymeric; an inference which is also supported by the fact that Nos. 17 and 19, containing the high nickel percentages of 4.66 and 5.59, show less than 1 complete molecule of sulphur in excess, and therefore require a multiplication of their several figures. Taken as a whole, however, the results of analysis are opposed to any assumption of homogeneity of structure.

Coming now to physical investigation, we are at once met by a feature that is conclusive against the hypotheses of "replacement" and homogeneity. I allude to the fact that nickeliferous pyrrhotite may be divided into two portions, one of which is magnetic while the other is non-magnetic. This fact has long been known to chemists. In 1879 Habermehl effected a separation of the magnetic from the non-magnetic portions of pyrrhotite for the purpose of obtaining a pure mineral for analysis. In 1890 T. J. McTighe applied magnetic separation in the treatment of the nickeliferous pyrrhotite of Canada; and in July of this year T. A. Edison applied for a U. S. patent in respect of virtually the same invention, and filed a specification containing the following statement:—

"I have discovered that where magnetic pyrites, called "pyrrhotite" is nickeliferous, as it usually is to a more or less extent, the nickel is not distributed generally throughout the whole body of the pyrhotite, but certain crystals are pure pyrrhotite or magnetic pyrites, while other crystals have some of the iron replaced by nickel and sometimes by cobalt, and that the crystals containing the nickel or cobalt are considerably less magnetic than the pure pyrrhotite."

Any statement made by Mr. Edison is deserving of respectful attention; but I believe that gentleman has frequently disclaimed anything beyond a rudimentary knowledge of chemistry and is therefore presumably open to correction in matters belonging to that department of science. Be this, however, as it may, I am safe in saying that pyrrhotite is rarely found in a crystalline form, and that crystals of nickeliferous pyrrhotite are as yet unrecorded as having been observed. Mr. Edison's mention of "crystals" is probably only a loose way of describing the minute fragments, particles or grains into which the massive pyrrhotite is divided by comminution.

Again, Mr. Edison speaks of the strongly magnetic particles as being "pure pyrrhotite," meaning thereby a non-nickeliferous iron sulphide of the general form $Fe_n\ S_{n+1}$. My own observations do not confirm the statement that nickeliferous pyrrhotite can be magnetically separated into nickeliferous and non-nickeliferous portions. A separation into two very distinct minerals or mineral mixtures is possible, and these contain very distinct percentages of nickel; but both are nickeliferous. The following results obtained by Mr. C. T. Mixer at the laboratory of the Emmens Metal Company will illustrate this.

Two samples of nickeliferous pyrrhotite were taken, one from the Gap mine, Lancaster Co., Pa., and the other from a mine near Sudbury, Ontario. These were very finely powdered and then each sample was carefully separated by means of a magnet into three grades, namely, "magnetic," "feebly magnetic" and "non-magnetic." The "magnetic" and "non-magnetic" grades were then analyzed and resulted as follows, after deduction of gangue:—

	Ni.	Fe.	S.
Gap *magnetic*	0.35%	59.97%	39.68%
" non-mag	15.59	43.00	41.41
Sudbury mag	1.30	58.27	40.43
" non-mag.	23.16	33.92	42.92

Treating these figures in the same way as those of the analyses recorded by Dana, we have:—

1. Molecular Constitution.

Sudbury mag	Ni	Fe 46.99	S 56.95	showing an excess of S 7.96
" non-mag.	Ni	Fe 1.535	S 3.394	" a deficiency of S 0.141
Gap mag	Ni	Fe 179.6	S 207.6	" an excess of S 26
" non-mag	Ni	Fe 2.891	S 4.864	" a deficiency of S 0.027

2. Proportion of Excess S to Metal.

Percentage of Nickel.	Proportion of S molecules in excess of $n+1$ to Ni molecules.	Fe molecules.	Ni+Fe molecules.
0.35	26.00	.1448	.1440
1.30	7.96	.1694	.1659
15.59	Slight deficiency of S.		
23.16	"	"	"

A comparison of the results here obtained with those from Dana shows conclusively that the magnetic minerals are of the pyrrhotite type, but that the non-magnetic concentrates are of a quite disimilar constitution; and as the latter are much higher in nickel than the former it is also clear that the nickel is *not* present as an element replacing iron in pyrrhotite. It is also apparent that the minerals Nos. 17 and 19 of Dana are mixtures of the magnetic and non-magnetic minerals found in the Gap and Sudbury samples examined by Mr. Mixer.

Much additional investigation is needed to determine the true constitution of pyrrhotite and its allied nickel compound. It may be that experiments as to the solvent action of molten ferrous sulphide upon iron disulphide and nickel sulphide will throw the needed light upon the subjct. Many geologists are of the opinion that the massive pyrrhotites of Canada and other places are the cooled remains of a molten mass: and every parcel of matte produced from a smelter is an object lesson respecting the varying mixtures that are possible under such conditions. Provisionally, therefore, we may regard the constitution of the minerals under discussion as represented by the following formulæ:—

Crystalline pyrrhotite.. $n\ (Fe_2\ S_4)$
Amorphous do .. $n\ (FeS).\ x\ (FeS_2)$
Nickeliferous do .. $n\ (FeS).\ x\ (FeS_2).\ y\ (NiS)$

In conclusion it may be well to say a word as to the practical problem of the magnetic concentration of nickeliferous pyrrhotite. The two samples above referred to as examined by Mr. Mixer gave the following results: 2 nickel pyrrhotite

1. Division of the total sample:

	Gap.	Sudbury.
Magnetic portion	58.66 per cent.	92.95 per cent.
Feebly magnetic portion	6.67 "	2.09 "
Non- " "	34.67 "	4.96 "

2. Division of the total nickel contents:

	Gap.	Sudbury.
Magnetic portion	16.25 per cent.	58.01 per cent.
Feebly magnetic portion	19.96 "	7.60 "
Non- " "	63.79 "	34.39 "

3. Total gangue in sample:

Gap	41.28 per cent.
Sudbury	10.7 "

4. Division of the total gangue:

	Gap.	Sudbury.
Magnetic portion	25.85 per cent.	75.51 per cent.
Feebly magnetic portion	7.12 "	9.07 "
Non- " "	67.03 "	15.42 "

5. Percentage of gangue in the portions:

	Gap.	Sudbury.
Magnetic portion	18.20 per cent.	8.70 per cent.
Feebly magnetic portion	44.00 "	46.60 "
Non- " "	79.80 "	33.20 "

The practical inferences from these figures are as follows:

1. Magnetic separation will give a rich nickel concentrate.
2. An ore with considerable gangue will yield more of its nickel as "concentrate" than will be the case with cleaner ore.
3. The concentrate from clean ore will be of a higher grade than that from ore carrying much gangue.
4. The nickeliferous portion of the mineral is attached to the gangue more firmly than is the non-nickeliferous portion.
5. The nickel is *possibly an essential constituent of the gangue instead of being a constituent of the pyrrhotite.*

This last inference is so opposed to the generally received teachings that I have instituted a fresh series of investigations with a view to determine its correctness or the reverse. The results shall in due course be communicated to the American Chemical Society; and, in the meantime, all I can say is that at present they seem to favor the supposition of the gangue being nickeliferous.

The Use of Safe Explosives in Mines. *

By E. Gilpin Jun., M. Can. Soc. C. E.

The question of the use of explosives in the provincial coal mines was forced on the attention of the Nova Scotia legislature by the explosion at Springhill. Here apparently no trouble had been spared by the Company to protect its workmen. The locality in which the explosion originated was worked with safety lamps, the shots were fired under the direction of skilled men specially appointed for the purpose, and then at long intervals, not for loosening the coal, but to remove a few inches of stone in part of the roof. Copious watering was resorted to for laying the dust wherever the workings were not naturally damp. In spite of these precautions it appeared upon a carcful enquiry that a charge of gunpowder had partially done its work, had flamed out, and the heat acting upon an atmosphere containing dust and gas gave rise to a very serious explosion. This showed that the mining practice of firing charges of gunpowder in places where dust and gas could be present was dangerous in spite of the precautions regarding its use.

After deliberation the Legislature enacted that when gas was found in any mine, in quantity sufficient to show in a safety lamp in three consecutive days, no explosive could be used for two months.

Provision was however made, that the Governor-in-Council could, upon the recommendation of a commission, including the Inspector and persons skilled in the use and composition of explosives, that any explosive was safe, relax the act in respect to explosives in favor of such safe explosive.

In considering the practical application of the use of explosives in coal mines, the first point to be settled is what constitutes a "gassy" mine, that is a mine in which the use of gunpowder becomes unsafe. The theoretical definition is that any mine in which gas is known to be given off may present it in volume sufficient to be ignited either alone or in connection with dust by the explosion of gunpowder. As a matter of fact small percentages are known by special tests to be present almost continuously in mines, although they cannot be detected by the best safety lamps in use. In all parts of the world in well ventilated mines, gunpowder has been continuously used for years with impunity in the presence of these minute percentages of gas. In such mines provided that they are damp, and free from dust, there is little danger even from excessive charges, or blown out shots of powder, so long as the ventilation is adequate.

Such mines when carefully managed and under proper discipline gradually and by imperceptable degrees, pass, as they are worked at an increased depth, into what may be termed the second stage, that of an increased evolution of gas, and usually of a greater degree of dryness. When this stage is reached a deficiency of ventilation in any district, coupled with dryness of the workings, produces a state of affairs highly dangerous in the event of flaming or blown out shots. The third stage is that of deep workings, which add to the dangers of increased exudation of gas, and general dustiness, those of extended fracture of the strata suddenly introducing volumes of gas directly into the workings or pressing it out of the old goaves. Under these conditions prudent management introduces safety lamps and abolishes the use of gunpowder. The second stage is the most dangerous, as when the conditions of safety and danger are balanced, a trifling mishap paves the way for a disaster.

Mining practice has so long sanctioned the use of open lights and high explosives in mines that have reached the second stage, that the reaction now setting in, in favor of their restriction, promises to seriously affect the economic exploitation of some coal beds. The Prussian Commission went so far as to classify as "gassy," mines in which gas had been detected once in two years. It is therefore apparent that in almost every district there are mines varying in their degree of danger. Any hard and fast rule, for example, precluding the use of high explosives whenever gas is found, would not affect the mines of the third stage, but would greatly increase the cost of the coal from the comparatively non-gaseous mines. In the case of many mines giving off little gas, there are serious expenses, off-setting the cheapness with which the coal is mined, such as faults, steepness of dip, the presence of stone, weakness of the roof, etc. Such mines would find it difficult to produce coal, if explosives were abolished.

As it was apparent that a mine at any given time fairly classed as not "gassy" might in a few days on cutting a fault, giving off gas, or entering a disturbed section of coal, become decidedly "gassy" it was considered that the limitation imposed in the act would give a fair warning of danger arising in the usual conditions of mining. In the case of mines naturally damp, and decidedly free from gas, permission was also made in the act that any local and temporary detection of gas would not exclude the use of powder until it became evident that the increased proportion of gas was likely to prove permanent.

It must also be remembered that explosives play an important part in mining in addition to their employment for loosening the coal. Faults have to be penetrated. often through stone, tunnels must be driven to connect seams, roofs and pavements have to be removed, etc. These operations when expedited by the use of gunpowder or high explosives, have frequently proved very dangerous, and the source of serious explosions in the presence of gas and dust. So much is this the case that there is evidence tending strongly to show that, in haulage planes containing much dust, and presumably almost entirely free from gas, shots fired to bring down portions of a stone roof have caused disastrous explosions. Still such operations are essential to working coal mines, and their cost would be enormous if they had to be performed by manual labour only.

Upon a careful consideration from every point of view of the difficulties surrounding the problem, it appears that the total prohibition of explosives would be almost impracticable, and result speedily in the closing of mines already compelled to use every economy to make both ends meet in the face of competition.

Under these conditions the importance became evident of ascertaining if there was any explosive that could be safely used in the presence of gas and dust, in order that the exploitation of the Provincial mines might not be injuriously affected. The International and Acadia collieries, in Pictou County, had for some time used Roburite, at first imported from England, but afterwards supplied from a branch factory in Halifax, working under the company controlling the patent in Canada.

The commission appointed to enquire into the subject, under the provisions of the act already referred to, comprised the Inspector and several mining engineers and practical miners familiar with the three principal mining districts of the Province. The Commission met several times at Stellarton, in Pictou County, and experimented in the collieries of the Acadia Company, and appointed a sub-committee to experiment in Cape Breton.

The general value of the explosives tested before the Commission at Stellarton, may be gathered from the following selection of experiments, conducted under the supervision of members of the Commission.

Two parties submitted explosives. The Acadia Powder Company of Halifax, which had been for some time engaged in the investigation of flameless explosives suitable for use in gaseous mines, produced two grades of a dynamite explosive, claimed to be rendered flameless by the addition of certain chemicals. As the explosives were experimental, it was not deemed necessary at that stage to consider their percentage composition. The Roburite Company submitted Roburite as manufactured by them at Halifax, giving its composition as 18 per cent. of chloro-dinitro-benzole and 82 per cent. of nitrate of ammonia. It may be remarked that the secretary of the English company intimated later that the compound as manufactured there did not contain over 12½ per cent. of chloro-dinitro-benzole, and that presumably it was made in Halifax of the same strength. The commission up to the date of its preliminary report, has dealt with the question of exact composition of explosives only in a general manner.

It may be remarked that in these experiments, the shots were fired with detonators, ignited by a victor battery.

1st Experiment.—Two 6 oz. cartridges of roburite were placed on the ground on the same wire, aud covered with a few shovelfulls dry slack coal. Both shots gave a short bright flash.

2nd Experiment.—One 6 oz. cartridge of grade "B," and a 3 oz. cartridge of grade "C," of the explosives of the Acadia Powder Company, were connected to the same wire, placed on the ground and covered with slack as before. On firing there was a flash from grade "C" cartridge, but none from grade "B" cartridge.

3rd Experiment.—A 4 oz. cartridge of roburite, covered with four inches of slack coal, gave a flash on being fired.

These experiments were made on a dark night, and as far as possible under the same conditions.

The tests were continued in the McGregor pit of the Acadia Coal Company. A number of holes were bored in firm coal, in the high side of the level, in a five foot seam, about half way between the roof and floor. The holes were three feet six inches deep, and from 1½ to 1¾ inches in diameter.

1st Experiment.—Charge 7 oz. explosive "B," hole tamped with clay for 25 inches. Shot blew the outside tamping off for a depth of 18 inches. No light visible.

2nd Experiment.—Charge 4 oz. roburite. Hole tamped with clay for 20 inches. Shot blew out tamping. No light visible.

3rd Experiment.—Charge 4 oz. explosive "B," hole tamped with clay for 20 inches. Shot blew out tamping. No light visible.

4th Experiment.—Charge 7 oz. explosive "B." No tamping. Shot gave bright flash.

5th Eperiment.—Detonator of Acadia Powder Company fired outside the hole alone and uncovered, gave flash.

6th Experiment.—A 4 oz. Cartridge explosive "B" with detonator in rear of cartridge, and pushed in the back of the hole, gave slight flash on being fired.

In the opinion of those witnessing these experiments, the flash observed when the explosives were fired, without tamping, was not greater than that due to the detonator, except perhaps, in the case of the fourth experiment in the McGregor pit. It is probable that the greater or less amount of flash visible in a number of experiments, may be due either to a lack of uniformity of the explosive mixture, or to the detonators not occupying, in each case, the same position in the cartridge. The fact was evident that the explosives, fired unconfined, did not give a flame, but a very brief flash of light. The blown out shots did not flame, nor did they give a light, a very slight tamping being apparently enough to delay the progress of the explosion long enough for the flash to have disappeared, when the rupture of the enclosing matter took place. It may be imagined that the sudden compression of the air in the vicinity of the charge might produce visible heat, in a manner parallel to the ignition of gunpowder by sudden compression of air in a cylinder.

Numerous practical experiments were made in this pit, substituting the new explosives for gunpowder in the ordinary working of the coal. These showed that as soon as the workmen understood the changed methods of apportioning the charge, tamping, etc, they got equally good practical results. As a specimen the following memo gives the particulars of a shot fired in one of the regular working places of the McGregor pit.

Working place 15 feet wide. Bench 6 feet by 7 feet, by 3 feet 9 inches high. (1575 cubic feet.) Hole 5 feet deep, 2 feet 6 inches from the higher side (the seam dipping about 1 in 3) level, and on bottom of seam. Charge 18 oz. "B" Explosive. First half of hole stemmed with clay, rest with slack coal. The shot was satisfactory. Coal hard and compact, and the bench had a layer of stone on top 9 inches thick.

The committee appointed to experiment in Cape Breton coals, which are softer than those of Pictou, reported that, in spite of their meeting with objections on account of cost, and prejudices in favor of the long established gunpowder, their opinion was that these explosives could readily replace gunpowder in that district.

At the close of the year the Commission submitted a preliminary report to the Governor-in-Council, in which they state that they had selected two of the explosives submitted, as apparently safe and adapted for coal mining, and that they had confined their enquiry solely to the question of safety in blasting, but had not gone into the question of cost, or of safety in manufacture, transportation, or storage, and that no investigation had been carried into the composition of these compounds pending the results of certain changes recommended by the Commission as calculated to render them safer.

The Commission recommended that any of the four explosives, approved of by the French Minister of Public works, August 1st, 1890, be allowed to be used, and any other explosive, not yielding as the product of its detonation any combustible matter, such as carbon, nitrogen, etc., or having its temperature of detonation higher than 1500° C. if employed in coal blasting.

Recommendations are also made as to the proper length of tamping. Arrangements were made for the issue of licenses to manufacturers, testing of samples, firing by electrical fuses by low tension electricity etc.

Since the report was made, samples of ammonite have been received from England. This explosive is put up in thin metallic cartridges to prevent the action of moisture on the nitrate of ammonia. The explosive, which is highly spoken of in England, is likely to prove expensive, where it comes into competition with other explosives, which can be supplied to the miner fresh from the factory, if not as well protected from dampness. Opportunity has hitherto been afforded only of testing this explosive in Cape Breton, and the results were not conclusive, but further tests will be made in Pictou County, where more experience has been gained in handling new explosives.

The Acadia Powder company have improved their explosive, and are experimenting with an addition which has, it is claimed, the power to effectually waterproof their ammonia nitrate. Their new compound is substituted for the grades "A" & "B" referred to in this paper. The compound contains under 20 per centum of dynamite, and has in addition to the nitrate of ammonia, a chemical, which, stable in itself, is calculated to neutralize any trace of acid that may be present. So soon as the changes in the explosives are finished, the Commission will probably resume its work, and it is hoped will be able to recommend, at least two explosives superior in safety to any yet introduced in England or on the Continent.

NOTE.—The final results, analyses, etc., will be shortly submitted.

Discussion.

Mr. T. C. BRAINERD said Mr. Gilpin's paper is a comprehensive and interesting account of recent efforts to obtain improved and safe explosives. Nothing can be more important than to find some method of mining coal that will avoid the terrible catastrophes hitherto incident to that industry. Great progress has been made already, as statistics prove, and the present discussion in all countries shows continued appreciation of its value.

Fortunately many mines are now successfully worked without explosives, but even when the position and character of the vein pemit removal of the coal by mechanical means, some blasting is generally necessary for sinking shafts, overcoming faults, and other purposes. The chief objection to the use in the coal of the modern nitro-compounds is that the force developed by the molecular change of their ingredients is not uniform, and is therefore unreliable as compared with the gradual combustion of gunpowder, which can be accurately measured and controlled. The expansion of the former depends on physical conditions, which vary in each case according to the pressure, temperature and other circumstances. Thus an explosive which, from its low specific heat or because the inner gasses are blanketed by a cooler envelope, shows no flame when burned in the open air, may develop brilliant combustion under the pressure produced by heavy stemming or other cause. Most of the "smokeless powders" have very little or no strength if fired in our Canadian winter when the thermometer is much below zero, but the same cartridge, allowed to remain in the chamber of a gun that has been heated by

* Report of the Nova Scotia Explosives Commission.

rapid firing, may shatter the barrel itself. The special means used for ignition also have great effect on the character of the explosion, the real discovery of Nobel, which made nitro-glycerine and dynamite useful, being the employment of the "Detonator." One of the "flameless powders" which has been most vaunted requires a detonator charged with no less than 23 grains of fulminate of mercury, an amount quite sufficient to explode even a very sluggish mixture of air and fire damp, and therefore an obvious source of danger. The electrical condition of the atmosphere modifies greatly these chemical actions. The mysterious and much discussed Elmore explosion was accounted for by one witness, an old mine viewer, as the "result of a tremendous lot of electricity in the air that night," but the explanation was not followed up by the Commission, although Mr. Chamberlain was its chairman and Lord Rayleigh one of the members. Yet the manufacturers of gunpowder in America learned long ago to close their mills on the approach of a thunder storm, not from fear of the buildings being "struck by lightning," but because experience proved that the air in the houses, charged with carbonaceous and oxygenated dust, would explode at such a time from a very trifling cause, that would have no effect in other states of the atmosphere. Some so-called safety compounds are as sensitive to shock under certain electric conditions as are Konig's flames to the musical note of the organ. In fact, all explosions may now be considered as rythmic motions, and there are probably few intimate mixtures of suitable ingredients that would not be promptly combined with detonation, if we could ascertain and produce the proper key-note. The object of the present study of the question is to avoid creating this exciting motor cause in coal mines.

Beyond the uncertainty as to what the resulting explosion will really be, there are economic and practical objections to many of the proposed substitutes for gunpowder. Some are liable to internal chemical change, extending even to spontaneous explosion when subjected to the climatic extremes of such a country as Canada. Others, like the compounds containing nitrate of ammonia, are deliquescent and alter rapidly in a damp atmosphere. Some, on burning, yield noxious or even deadly gasses, the coroner's jury having in March of this year given the fumes of roburite as the sole cause of death of a miner at Wigan. All are much more expensive than gunpowder, adding a considerable amount to the cost of each ton of coal, and many break the coal so fine as to create a further loss from the dust and slack. Finally, nearly all require an expert to properly use them, while the ordinary miner is reasonably familiar with the safe handling of gunpowder.

Concerning the latter, one decided source of danger comes from an excessive quantity being employed. Most mine operators sell the powder to their men, at a profit, and therefore think they have no interest in limiting the amount consumed. Hence the drill holes are generally overcharged, causing a volume of flame at each blast that could be entirely avoided. It should also be remembered that all European experiments and comparisons are from gunpowder made from nitrate of potash, while on this continent nitrate of soda is used almost exclusively for blasting purposes, giving a very different result in temperature of ignition, specific heat and amount of flame.

If any substance can be found that by its combustion or otherwise will develop enough controllable force to promptly and cheaply dislodge coal and other minerals without producing such heat or shock as to inflame fire damp, the world will be a great gainer. It has not been done yet. Many who have investigated the subject thoroughly and without prejudice think that ordinary gunpowder is safer than any thing so far produced. In gassy mines the use of any explosive should be very limited, and should be in the hands of a competent blaster, who fires the holes by electricity and between shifts, that is when all the men are out of the workings.

MR H. S. POOLE, said: As regards the practical application of flameless explosives a little may be said. When compressed lime was so much talked of in England some years ago trials were made with it here, but the results were not considered sufficiently encouraging to continue them. Two years ago in one of the pits, under the writer's charge trials were made of Sir F. Abel's water cartridges, but so much time was taken up in the preparation of each shot that it was felt they would not suit for general use in such cases as are here, in which as many as three shots a day may be required for each working place. The shots necessarily being under the supervision of specially appointed shot firers, where a large number are fired they would entail the employment of so many extra officials at a very heavy increased cost. Besides it was evident that a comparatively large number of cartridges might lose their included water so that the search for safety in that direction was abandoned.

Trials would also have been made with such compounds as carbonite could they have been obtained otherwise than by importation from Germany; but not being available, applications were made to the local factory of the Acadia Powder Co., and a compound was prepared which when tried in April, 1890, was, with respect to flamelessness, found satisfactory. Practical difficulties in other directions stood in the way of its general use at that time, and it was not until 1891 that opportunity was had for trial and subsequent use flameless mixtures from the same company and from a branch of the English Roburite Company.

Opposition to the introduction of these explosives was raised by the miners, for a life long experience with black powder had familiarized them with its capabilities, and they objected to the price and the fumes of the modern explosives. The complaint about fumes is no longer heard, many men contending they mind them no more than the smoke of powder, and with the worst of the explosives by keeping away from the seat of the shot for a couple of minutes, no inconvenience is felt,

As to price, the miners who have learnt to proportion quantity used to the work to be done have accepted the gain when the shots are successful, and the loss when misfires occur, and shots are lost.

All these explosives require detonation to make them efficient, and the electric fuses necessary are comparatively costly and doubly so when the shot fails to accompany the detonation of the cap. When this occurs the charge sometimes burns in the hole without exploding, and almost invariably so quietly that no sparks or flame are seen to come through the tamping. But we had one shot out of some twelve thousand that had been then fired with one of these mixtures, that, burning, only showed sparks but no flame, at least so the shot-firer and a miner contended, and the writer does not question their veracity. At the same time he has no reason to believe that the sparks so seen were of such a nature that they would have fired gas had it been present in quantity.

The introduction of these "flameless" explosives is to endorse one great element of danger in coal mining. Common powder does the work required of it in coal well, it sends from the working face great blocks little shattered, if the shot has been, as the miners say, "properly worked;" while all the high explosives and many of the flameless variety have a local shattering action which largely increases the percentage of slack produced, and thereby seriously affects the profits of the mine; the market value of large and small coal differing very considerably. There has for a long time been recognized the danger attending the use of black powder in pits of a certain character, and the Legislature has imposed restrictions on its use, but the immunity of accident in some mines freely producing gas, and in which millions of powder shots have been fired without disaster, also shows that there are conditions when the use of powder is reasonably safe. The line of safety is a debatable one, but the disastrous side is now generally considered to be where there is fine dust. Not that the dust itself is generally regarded as likely to start an explosion, but that it keeps up an explosion which a cap full of gas may have started, and which alone in a damp pit would have done no damage. To lay the dust, watering has been practiced, but this cannot be done thoroughly in some mines, as for instance where the coal itself is so dry that the working at the face creates a cloud of dust, and where also the roof is broken and timbered, and so offering lodgment for dust in places impossible of access. On account of dust the writer abandoned the use of powder in one pit four years ago.

The writer said that he lately had the honour of reading before the Mining Society of Nova Scotia, a paper† on this subject in which the advantages and difficulties attending the introduction and substitution of "flameless explosives" for common black powder in the mines he had to do with were enumerated. He did not consider, therefore, that the present occasion called from him even a partial repetition of the experience therein related; he thought there was, however, one point introduced by Dr. Gilpin which would yet require legislative reconsideration, and that relating to the test defining what was a fiery mine.

The safety lamp test which drew the line on the appearance of a blue cap in the presence of inflammable gas could now hardly be considered a fixed standard, for it not only was subject to "personal error," but now varied with the style of lamp used, some lamps of modern construction being more sensitive than the Davy or even the Mueseler. The spirit lamps of Peeler and Ashworth detecting percentages so low that atmospheres carrying them have been, and even now are by many considered safe to work in.

For his own part he contended that the danger arising in mines from the emission of fire damp was not in proportion to the percentage of gas evolved regardless of other conditions, but that it was largely governed by the hydroscopic state of the air. A free evolution of gas, readily to be both seen in the lamp and heard issuing from the cracks in the coal of a damp mine was not to be dreaded to anything like the same extent as a much smaller quantity that imperceptibly escaped into the atmosphere of a dry and dusty pit. He goes further than Dr. Gilpin, and says that "gunpowder has been continuously used for years with impunity in the presence of" not minute percentages, but large percentages of gas in damp mines, and therefore he is disposed to contend that as it is a general maxim that legislation should interfere as little as possible with trade, all mines showing gas should not necessarily, therefore be subject to the closest restrictions, provided that the hydroscopic condition of the air is at no time disregarded. In thus questioning the necessity and advisability of sweeping enactment to which popular clamour flies for relief when sudden disaster excites attention he ventures to do so as one whose past ought to enable him to speak with experience; he has to do with mines where it was mentioned before a Royal Commission in 1835," "gas issued with the hissing noise of ten thousand snakes," and in his practice was the first to introduce in Nova Scotia, improved forms of safety lamps and to see the advisability of entirely giving up the use of powder in a dry mine. His surprise is not that disasters do sometimes occur, but that they occur so seldom.

†Printed in the CANADIAN MINING REVIEW, July, 1892.

He does not consider the clause in the present Mines Regulation Act‡ respecting the use of explosives where gas is occasionally found as sound. It makes the inducement for an imperfect test very great, for example to stop the test six inches of the roof, when in the last six inches the probability of finding gas is greatly augmented; or to send ahead of the gas trier a man with a bag to beat and disturb the air at faces where gas is most likely to accumulate. He believes in legislative recognition of the modifying influence of moisture and in the intensifying of danger in dryness, he agrees with Dr. Gilpin in regarding mines of his second class, occasionally producing gas as proportionally more liable to accident than mines recognized as "gassy." But to avoid misconception he desires to add that not only is he an advocate for the so called flameless explosives as reducers of danger, but that he began their use prior to their consideration by the Legislature. As an illustration of the extent to which gas is given off, he would mention that a pair of leading places in the deep seam at Stellarton, N.S., produce 180 cubic feet per minute and that the evolution is constant.

MR. GILPIN in reply said he would remark with respect to Mr. Brainard's example of the deadly fumes of roburite, that practical trial has shown that in a properly ventilated coal mine its fumes are not objected to by workmen. And the same is the case with the flameless powder of the Acadia Powder Co. If a moment be allowed for the fresh air to mix with the fumes no ill effects can be noticed. The miners, when they are once initiated, as a rule, find little difficulty in adopting the new explosives. No gold miner now raises any objection to using dynamite. Whatever may be the weight of opinion of individuals as to the percentage of safety of gunpowder over that of the so-called safety explosives, it is conceded that the thorough and unprejudiced examination of the subject by several European governments has resulted in very emphatic repudiation of gunpowder in the presence of gas or dust. With regard to the definition of a gassy mine it may be said no two mines are alike, and the adoption of a "Plimsoll" mark is difficult. The dampening of the air currents is a great safeguard as suggested by Mr. Poole. But in many large and deep mines it would be attended with much expense. It may be remarked on Mr. Poole's statement that the classification of mines as adopted by Provincial legislation makes a great inducement for imperfect examination, is hardly just. No legislation requiring dozens of men daily to do certain things under ground, out of sight, and not before witnesses, can be enforced unless the gas examiners and their employees choose to recognize the fact that the law is one instituted for their safety, and they act as honest men. The writer thinks most mine bosses would hesitate to suggest to a gas examiner that he slur over his work if he reflects that such a course might lead to his being indicted for manslaughter.

‡"And may order that the use of any explosive is obligatory under this rule only if inflammable gas is found in two consecutive days on any two consecutive weeks." Sec. 24, chap. ix., 1891.

Failure of Winding Ropes in the Dortmund District—Nearly the whole of the winding ropes used in the Dortmund district are of cast steel wire. In 1890, 187 round ropes and 45 flat ropes were renewed. Ten of the flat ropes and 19 of the round ones had been in use for less than 200 days, while nine of the round ropes had lives exceeding 1,000 days. Only six of the flat ropes lasted more than 400 days and none more than 1,000 days. Of the five ropes which broke in 1890, four were flat ones.

The Manufacture of Briquettes.

Some notes on compressing brown coals into briquettes are given by Mr. B. Straube, in the (Annual Report for the Secretary of Mines, Victoria, 1891, pp. 49-52, one plate.) The principal point in the manufacture consists in the proper selection of the methods for drying and heating the coal before it is compressed. Unlike other coals, brown coal contains enought bituminous material so that admixture with pitch or other binding material may be omitted; but as the constitution of coals from neighboring districts varies greatly, very careful selection of the methods and machinery is requisite. The processes are considered under three heads:—

Crushing the raw and wet coal.

Drying and heating the crushed material.

The compression of the brown coal into briquettes.

Crushing is best performed between a pair of rolls—one plain, the other closely fluted. The crushed material is passed over an inclined sieve, or over two if the material is fibrous, as it is essential that large pieces be removed. The coarser material is re-crushed or is used under the boiler. The crushed coal is then taken by conveyors to the drying stoves, where the water is reduced about 35 per cent. down to 15 per cent., which is found to be a suitable amount. As a rule, highly bituminous coal contains less water and requires a lower temperature to dry it. The ovens which have been adopted may be classified under five heads, namely, those drying by (a) fire-gases alone, (b) steam only, (c) hot air only, (d) hot air and steam, (e) fire-gases and steam. Examples of each of these types of ovens are described and illustrated. A recent improvement is the use of a large re-heating chamber, in which the coal from all the ovens is collected and re-heated. Some coal indeed requires a second crushing and sifting before it is re-heated. The ratio of compression varies with the coal, but averages 45 to 50 per cent. The author concludes with an estimate of the expense of compressing brown coal in Victoria, the Gippsland coal being employed.

Peat Charcoal and Bog Ore.

By Walter J. May. *

The success which has attended the conversion of peat offers an opportunity of reducing bog iron ore in places where coal is not readily obtainable, and although probably some trouble would be experienced in the earlier part of the business owing to the form in which the charcoal would be presented, there is no reason why this should not be soon overcome. If necessary, the charcoal could be compressed to secure additional value in the furnace, but as the furnaces would be, comparatively small, the burden would not be so great as in a coke furnace. The iron would probably be of excellent quality, and would thus make some amends for any additional cost incurred. As probably the ore would be fairly free from slag-producing materials) limestone or other fluxing agent would only have to be used in small quantities, thus reducing one element of expense, and probably the working would eventually cost no more than that of an ordinary charcoal furnace.

Speaking generally, peat charcoal would lack both the size and hardness of live oak and other wood charcoals, but it would not possess much more impurity unless the peat beds were charged with layers of earthy minerals or deposited silica. It might be found necessary to use larger quantities of peat as compared with wood charcoal to secure the same results, but as the peat can be very cheaply converted, this would make hut little difference, difficulties being more of a mechanical than a financial character.

The ore would be cleared from mud and would also be of a fair size, or, more correctly, an admixture of sizes, and the separation from mud and the finer matters would be very simple. In fact, by following the method adopted at Lac-à-la-Tortue, near Quebec, it should be quite possible for anyone interested to design simple washing apparatus for the purpose. At Lac-à-la-Tortue the ore occurs in the greenish mud, and in the sand underlying the mud in the lake bed, and the water having been lowered some 7 or 8 ft. recently, the ore in the exposed portion is worked by hand, while that under water is lifted by a chain dredger having three rows of buckets. The ore, which is in the form of irregularly round flattened masses, varies in size from the size of shot to that of concretions several inches in diameter, and that extracted by hand is washed clear of mud in hand sieves of suitable mesh, the process being somewhat similar to sand washing as adopted by plasterers in this country. The ore, and mud, or sand, lifted by the dredger is discharged into a revolving sieve set at an inclination, and along its axis a series of jets of water are arranged, and these wash the ore clean, the washed ore passing direct into scows alongside, and in these it is taken to one end of the lake, and from thence conveyed by rail to the furnaces at Radnor.

The process of cleaning is not only simple, but also effective, and there is no reason why the same method should not be adapted to other than bog ores, where they are suitable for such simple treatment. It is, however, necessary in any case that the screen be of sufficient strength, and that water be at hand in adequate quantities. Where the ore is free from adhesive matter and it is not desired to secure the whole of the finer particles of ore—and these are usually the richest in metallic value—then a revolving perforated screen appears to be far more suitable than the hooded barrel or cylinder, as less weight has to be revolved, while cleaner work should be produced if the axil water jets are properly arranged, and a screen having as small as 3 mm. round perforations should work well without choking. If built of plates about 4 ft. long and properly carried on friction rollers, there should be little difficulty in working a screen of some considerable length, but it must always be remembered that the smaller the perforations the thinner the plates, and as the thickness of the plate must be less than the diameter of the perforations some kind of strengthening would have to be used with very fine screens, particularly as they wear thinner and become less able to withstand torsion.

The way in which bog ore is formed is both curious and interesting, and although probably slightly varying in different localities, practically—although not actually—the process is the same everywhere. The water, owing to the decay of vegetation, becomes charged with acids, and these dissolve out the ferric oxide from the sand through which the water percolates. The water and the contained proto-salts of iron rise to the surface of the pools or other comparatively still waters and become oxidised, the salts of iron becoming insoluble, and are then precipitated to the bottom, where they form concretions round nuclei of some other material. Successive layers of the oxide form around these, and hence they become larger. In some instances it will, however, be found that the successive layers of oxide are not produced, but that the form taken is that of a fine granular powder, while in others the oxide and gravel concrete together in masses, and in this state the amount of siliceous matters renders the ore useless for smelting.

Possibly, also, oxygen is formed in some of the strata under the water, and as it escapes, exercises an amount of oxidising force on the ferric salts in the water, and this leads to the formation of concretions of ore in positions not otherwise favorable. It is certain that this ore is continually being formed, as places in the Lac-à-la-Tortue—places which were exhausted some eight or ten years since — now yield profitable quantities again. Whether this rapidity of formation is a general thing the writer is unable to say from personal observation, but provided the conditions are favourable, there is no reason to doubt that such is the case.

Taken altogether, the possibilities in regard to the utilization of peat and bog ore in the production of charcoal iron are good, provided the mechanical difficulties in dealing with the peat charcoal are overcome, and in this respect it appeals to the writer that a very little amount of experimental work would be found necessary, as the burden to be borne would not be very great comparatively. The matter is one for investigation, and in many places this can be done at a small expense.

* Colliery Guardian.

Patent Fuel Machinery.

By Dr. C. M. Percy. *

What shall we do with our Small Coal?—This is a question which has attracted a great amount of attention in the United Kingdom for many years, and as time goes on the amount of attention will certainly increase. The percentage of small coal is considerable in most mining districts, and very serious in some; there are, of course, exceptions, and the writer of these notes was consulted, a few months ago, as to coal breaking machinery for the purpose of reducing the size; such machinery is largely in use in the United States of America. With us at home, however, coal requiring machinery to reduce it in size is exceptional, and our trouble is the amount of very small coal, amounting to many millions of tons a year. Every ton of this small coal costs as much to produce as round coal, but, as everybody knows, it sells for a great deal less, and in the majority of cases at less than the cost of production.

The proportion of very Small Coal will not Diminish.—The proportion of very small coal will certainly not diminish with the increasing depths of the mines that we shall have to work, and anything which will tend to increase its marketable value will be beneficial to the mining industry. A very large quantity of small coal is consumed every year in coke manufacture, for which purpose the small is not only not inferior, but expense is incurred in crushing or disintergrating the coal almost to dust. The smaller the size the better for coke making, and the more uniform the quality of the coke produced.

The great trouble with Small Coal.—The great trouble with small coal is the amount of dirt intermixed with it; this has to be removed, otherwise the coal will practically be valueless. Our mining friends on the Continent of Europe were forced by circumstances to take this matter in hand long ago, and consequently are much ahead of English collieries in the cleaning and assorting of coal; they have been successful in raising the process to the dignity of an art. Latterly, in the United Kingdom we have followed suit, and in many of our mining districts we now have elaborate plants for freeing small coal of its impurities, and sending it into the market in sizes suited to the various requirements. This kind of thing will increase, and it is not improbable that the coal industry will find salvation in the cleaning and sizing of small coal.

Every quality of Coal will not make Coke.—But every quality of coal will not make coke, although by the more modern methods of coke making really good coke is produced from coal which the old fashioned arrangements were not capable of dealing with; and even coal unsuitable in itself is now producing good coke when mixed with other qualities of coal. Still, with all this we have millions of tons of small coal raised each year which cannot be used in coke making, and which, sold in the raw state, scarcely pays for carriage.

Briquette Manufacture has stepped into the Breach.—Briquette manufacture has stepped into the breach, and by utilizing the very smallest of the coal in the form of briquette or bricks it can be conveyed any distance by sea or land without crushing and without loss, and for domestic and other uses serves as well as round coal. The briquette process is not new, having probably been practised, more or less, for nearly half a century.

The Briquette Process often a Failure—It has been tried in different places by different people, and often failure has been the result; sometimes the coal was unsuitable, and sometimes the machinery was imperfect. The writer, during a visit to the Yorkshire coal-fields a few years ago, was shown a briquette which was said to have cost its owners thousands of pounds.

Successful Briquette plant at Uskside.—Success has, however, come to some who have tried the process, and during the period of the last Glasgow exhibition, at least one firm in Scotland was doing a very good home and foreign trade in coal briquettes.

The Briquette Process.—Usually in briquette making there is a combination of coal and pitch (we say usually, because there is an arrangement which lately came under our notice, no pitch was used), and in the machines the coal and pitch, after having been ground and mixed, enter the Pugmill. The Pugmill is supplied with steam-jets, and the coal and pitch are there thoroughly mixed, and the pitch melted, and thoroughly incorporated with the coal, thence it falls into the feeding pan, and from there falls into the moulds of a revolving table which passes underneath. At a certain point in the travel of this table steam is continually admitted to the steam cylinder, and great pressure is brought to bear upon the coal contained in the moulds. Each mould carries its own piston with it, and consequently there is no necessity for the table to stop at an exact point, which is always a great difficulty with machines dealing with rough materials. The coal in the mould, after being pressed, is gradually pushed out of the mould by means of a piston travelling up the incline plane, and is then delivered either into wheelbarrows, or, preferably, into an endless band, as may be arranged. The Uskside Engineering Company have the advantage of being well within the range of the great industrial district of South Wales (being situated at Newport, Monmouthshire), which is eminent for the adoption of improvements in coal production, and in iron and steel manufacture.

South Wales the Home of the Briquette Manufacture—By its extensive adoption of these appliances, South Wales has almost earned the name of the home of the Briquette manufacture, and at one time practically exported the whole of its production. Latterly a good deal has been used for domestic purposes at home, and there is no valid reason why other mining districts should not endeavour to emulate so good an example both in export and in home consumption.

The Briquette Plant Varies in Power—The Briquette plant varies in power and in the quantity capable of being produced, some machines making as much as 400 tons a day. The Briquettes also vary in size from a minimum of one pound in weight to as much as 15 pounds.

Recent Improvements in Briquette Machinery—The most recent improvements in Briquette machinery include small, self-contained plants, capable of making about six tons per day of ten hours, in Briquettes weighing one pound each. These machines are specially designed for the use of large coal merchants, who, in the course of their trade, have a quantity of unsaleable small coal to deal with. It has been a pleasure to the writer to describe so good a type of machinery for so useful a purpose, namely, increasing the value of small coal.

The Uskside Engineering Company—Some years ago it fell within the writer's duty elsewhere to describe another arrangement, equally as good, of the same class, by the same firm, the object being to lessen the consumption of coal in the operation of colliery winding. We refer to the application of automatic expansion gear to colliery winding engines, by which a saving of 25 per cent. of coal consumed for steam generation has been effected.

* The Science of Art in Mining.

Preserving Wire Ropes.—For the purpose of a protecting coating for wire ropes which are laid on the ground or which come in contact with water, a mixture of thirty-five parts of slacked lime and sixty of tar is recommended. This mixture is boiled and the rope painted with the hot mixture. Linseed oil and vegetable tar or grease with graphite form good paints for dry-lying ropes.

Endless Rope Haulage.—The endless rope system of haulage, which has displaced the single rope-system at the Mitchell main colliery, is described by Mr. T. W. H. Mitchell, in the *Transactions* of the Federated Institution of Mining Engineers. At this colliery the Barnsley bed is worked on the long-wall system, at a depth of 307 yards. The engine is placed on the surface and runs at nineteen to twenty revolutions per minute, and drives the rope at about 50 yards per minute. The rope is 1¼ inch in diameter, and is wrapped three and a-half times round a taper drum 9½ feet in diameter. Trucks are attached to the rope by chains 12 feet long, one end being hooked to the drawbar, and the other end wrapped twice round the rope, and the hook brought across the chain when extended. Catches and means for returning the vehicles to the rails are fixed every few yards, and a guide-rail is fixed between the two tracks to prevent the full trucks from fouling the empties.

The Manufacture of Patent Fuel.—According to Mr. J. Clark, in the *Transactions* of the Mining Institute of Scotland, the first recorded attempt to introduce the manufacture of agglomerated fuel into England was in the year 1594, when Sir Hugh Platt published a work entitled, "A New, Cheap and Delicate Fire of Coal Balls." He describes his project as one to sweeten sea-coal, so as to make it a substitute for wood in domestic economy, by mixing loam with the pulverised coal. There are about 385 specifications relating to patents for inventions of artificial fuel made from small coal between the years 1799 and 1885, and of all the materials tried, pitch remains the only one in regular use.

At Ormiston Station colliery a small plant for the manufacture of patent fuel was erected two years ago, and is described in detail by the author. The coal and pitch are ground together in a disintegrator and are stirred and heated to the proper consistency for compression in a pug-mill. The mixture is received in a pan-mill with revolving arms in it to fill the moulds, and the blocks are compressed in a press cylinder under a pressure of 12 cwt. to the square inch of block surface. The whole of the machinery is driven by a pair of coupled engines with 10 inch cylinders and 20 inch stroke, supplied with steam at 40 lbs. pressure. The speed of the engine is 60 revolutions per minute, and that of the main shaft of the full plant is 95 revolutions per minute. The machine turns out three tons of fuel per hour, the quantity of pitch used being 9 to 10 per cent. of the finished fuel. The size of the briquette made is 6 x 4 x 3⅝ inches, and its weight is 4 pounds.

New Glasgow Iron, Coal and Railway Company—Description of the New Works at Ferrona.

The actual work on the plant of this company commenced in April, 1891, a great deal of preliminary work had, however, previously been done; the plant was put in operation September, 1892. The works comprise the following departments:—

1st. A complete railway system, connecting the ore and stone quarries with the furnace plant, and with the I. C. R. R. at Ferrona Junction.

2nd. Numerous ore mines, limestone quarries, ore washers, etc.

3rd. A complete coal-washing plant.

enclosed.

4th. A complete coking plant.

5th. A complete blast furnace plant.

The ore and limestone is brought to the stock house on the company's own railway. This stock house is a large wooden structure, covered with corrugated iron, the size of the building is 91 feet in width, by 250 feet in length, thus giving a large floor space to store ore, limestone, etc. The ore has been washed before it is stored in this building. The coke used in the furnace is brought to the stock house from the ovens in the charging buggies, two of which are placed on a flat car pulled by an endless rope, these loaded buggies go right to the furnace, two empty ones being returned on the car to the coke ovens to be loaded.

Within the stock house are located the stock scales, on which all material (stock) going into the furnace is weighed.

The ore, limestone and coke from the stock house is now taken to the top of the blast furnace by means of a double elevator, located in an all iron hoist tower. The elevator cages are worked by an automatic hoist engine, located at the foot of the hoist tower.

The hoist tower is connected on top with the blast furnace proper by means of an iron bridge. The buggies, with material are dumped on the bell of the furnace, which is lowered or raised by the top-filler by means of an air cylinder.

The blast furnace proper is of modern design and fitted up with the most modern appliances. The clear lines of the furnace inside of the brick work are: Height, 65 feet; bosh, dia., 15 feet; dia. of crucible, 9 feet, 9 inches. There are eight tuyeres and two cinder notches located within the crucible.

In front and surrounding the furnace is the casting house, 50 feet wide, by 135 feet long, constructed entirely of iron. The pig iron is taken from this house on little cars to a scale located at the end opposite of the furnace. After being weighed the pigs are broken in half, graded into the different qualities, and stored in the pig iron yard ready for shipment.

The furnace has two downcomers (gas flues), one carries the gases to the hot blast stoves, the other to the boilers. There are three hot blast stoves, of the three-pass Massick and Crooke type, each stove being 16 feet 6 inches in diameter inside of shell, and 60 feet in height. There is also located a chimney on top of each stove, 4 feet in diameter by 35 feet in height.

Each stove is lined with about 160,000 fire bricks. The aforementioned downcomers bring the gases from the top of the furnace to dust catchers and gas washers located at the bottom, from here the cleaned gases are either taken to the stoves to heat them or to the boiler plant to raise steam. The air necessary to smelt the ore etc., in the furnace, is produced by two powerful blowing engines, each weighing about 90 tons. These engines have steam cylinders of 36 inches diameter, air cylinders of 84 inches diameter, and 4 foot stroke. The cold air leaves the blowing (air) cylinders of the engines under considerable pressure. It passes through an iron pipe 30 inches diameter, (cold blast pipe), to the previously mentioned stoves, while two stoves are being heated by the waste gas, the third stove receives the cold air from the engines, this air becomes very hot while passing through the red hot brick work of the stove, and is taken by means of a fire-brick-lined (hot blast) pipe to the tuyeres of the furnace, thus reducing the fuel consumption very materially as compared with the old style furnaces, where the air from the engine is used cold.

The blowing engines are located in a brick building of very strong design. The building is 35 feet wide by 60 feet long, and 35 feet high below the roof truss. This building contains also two powerful boiler feed pumps, two feed water heaters and various steam, pressure and air gauges.

The steam required is generated at the boiler plant, comprising four double batteries of tubular boilers, designed to carry a pressure of 100 pounds per square inch. Each of the eight boilers is 6 feet in diameter, 20 feet long, and contains 52 tubes, each 4½ inches in diameter. The boilers are heated by the waste gases, the draft is produced by an all-iron chimney, 7 feet 6 inches in diameter by 125 feet in height. The chimney is lined with fire-bricks 4 inches in thickness.

The boilers are located in a wooden boiler house, with a tile covered roof; this house is 42 feet wide by 94 feet long. The water required is pumped by two powerful duplex pumps, from the East river direct, into an iron stand pipe (water tower) 10 feet in diameter, 80 feet high; all water used at various points of the plant comes from this stand pipe under a pressure of about 40 pounds.

The company also has a fully equipped chemical laboratory, where all ores, etc., are carefully analysed as far as necessary. Besides the afore-mentioned appliances, there are numerous other machines, etc., amongst them two complete ore washers, two locomotives, cinder cars, railroad cars, etc.

A large number of steam radiators, etc., are provided wherever there is danger of freezing in winter.

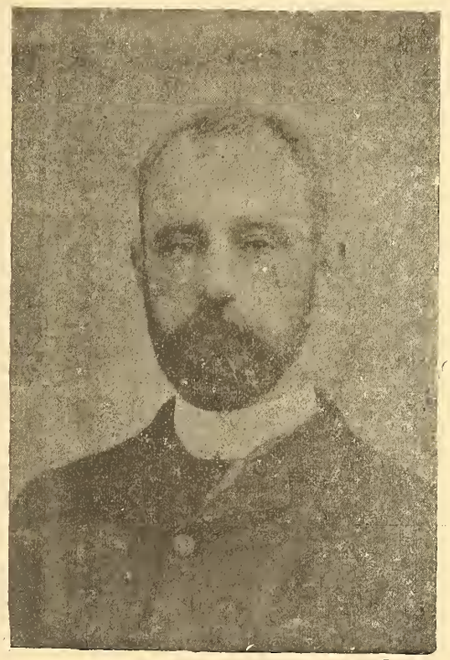
Coal Washing Plant—This plant was put in successful operation in May, 1892, and has been in constant operation ever since. The plant was built with the idea of washing the fine coal from various mines, the washed coal to be used for coke purposes. In connection with the coal washing plant, there is a retort coke oven plant of 54 retort coke ovens, having a daily capacity of about 175 tons of coke. The coke is pushed out with a special machine, a coke pusher. The attached drawing shows the general arrangement of the washing plant, C 127.

The coal from the various mines arrives on the railroad tracks A1 and A2, and is dumped into the pits B1 and B2 (a different kind in each pit). From these pits the coal is taken by means of bucket elevators C1 and C2, to the shaking screen D. This shaking screen has double eccentric motion, imitating hand screening as much as possible; the mesh of the screen is ⅜ inches.

The material too large to pass through the perforations drops into the crusher rolls E1 and E2, and is again taken after the crushing, to the shaking screen D, by means of the bucket elevator F.

The coal passing through the shaking screen D is taken by means of the bucket elevator G to the separating screen drum H, which separates it into three sizes: 0 to ⅛ in., ⅛ in. to ¼ in., ¼ in. to ⅜ in.

The different sizes are carried by means of chutes to the various jigs J to J8. These are all two-compartment feldspar jigs, arranged with variable stroke. Each screen compartment is 28 inches wide and 49 inches long, so that the coal must travel a distance of over 8 feet while being washed.



Mr. John F. Stairs, M.P., Halifax, N. S., President New Glasgow Iron, Coal & Railway Co.

The washed coal flows in gutters to the large elevator boot K2, and is elevated from there to the top of the storage tower by means of the perforated bucket elevator I2, which discharges the coal on the distributing conveyor M, which distributes it into the various compartments N of the large storage tower.

The two jigs shown in dotted lines, the elevator boot K, and the elevator I, are arranged to be put in if the plant requires enlargement.

The slate from jigs J to J8 is discharged into elevator boot Q, and is taken from there by means of a perforated bucket elevator R, and dumped into railroad cars ready to be taken to a convenient dumping place.

T is the centrifugal pump which distributes the required water. The water after being used always returns to the centrifugal pump and is used over and over again. There is no loss of water except that absorbed by the coal, and enough fresh water must be added to make up for this loss.

N is the steam engine of 100 h.p. to drive the entire plant.

The elevators are all of special construction and have very large buckets, and automatic feed, etc., and are run at a very low speed.

As will be readily seen the entire plant works automatically and consequently requires only three men to run it.

The coal washed contains from 17% to 35% of ash, besides in the neighborhood of 2½ to 3% of sulphur; the washed coal contains in the average 10% of ash or 1% more than the fixed ash (9%) of the coal. This is a remarkably good showing and is seldom equalled at any washery in existence. The fixed ash cannot be reduced by any method. Coming within 2% of the fixed ash is considered excellent work.

The sulphur is reduced by washing from 2½ to 3% down to 1·35%, the sulphur still left is organic sulphur and in combination with alumina or lime.

Jigs J to J5, was in the original plant; J6 to J8 were added when the additional retort coke ovens were built. The total capacity of the plant is now 300 tons of coal in ten hours.

Coking Plant—In addition to the coal washing plant, drawing C 127, already described, there is a battery of fifty-four retort coke ovens, Bernard's system (improved coppée).

Drawing C 149, shows the complete coking plant. The plan shows first: A side elevation of the ovens with section GH; second, a top view and sections A B, C D, E F, and K L; third, a cross section, M N, through the centre of the retort, and finally a cross section, O P, through the centre of partition wall between every two ovens.

1 marks the original battery of 36 ovens, built two years ago; 2, the eighteen additional ovens built in February last; 3 and 4 are the chimneys for each battery in case the surplus gases are not used for steam raising; 5 shows the place where the coke pushing machine travels parallel to the ovens; 6 is the coke discharge side; 7.7 are the tracks for door-lifting windlasses; 8, 8, 8 are the tracks for the coal charging buggies (lorries); 10, coke pushing machine (ram); 11, hydrants to supply the cooling water; 12, gas flue; 14, 14, 14, 14, cooling flues; 15, 15, 15, coal charging holes; 16, 16, air inlet valves, for the air necessary for the combustion.

General—There are 54 retort ovens in all, each retort (oven) has the following inside dimensions: Length, 33 feet; height 6 feet 6 inches (under roof); medium width, 23½ inches. Each oven (retort) is charged with about 7 tons of washed coal (all below ⅜ in. mesh) every 40 or 48 hours; the 54 ovens produce every 24 hours between 115 and 120 tons of first-class large coke, which is all used in the blast furnace of the company. The coal used yields 73 or 74% of large coke right along, the same coal only yields 60 per cent. max. in the bee-hive oven. Each oven can supply 130 to 150 square feet of boiler surface for steam raising if desired.

The ovens are built of the best quality of fire bricks obtainable, the composition of the fire bricks varies in the different parts of the oven and is specially made to meet the various conditions of heat, reducing cost of repairs to a minimum, away below those arising at bee-hive ovens.

Mode of Operation—Each two ovens work together and for this reason the ovens are charged alternately; one day the ovens 1, 3, 5, 7, 9, etc., uneven numbers are pushed, the next day the even numbers, 2, 4, etc., are discharged; this arrangement makes it possible to work a hot and cold oven together, utilizing the surplus heat of the hot oven to heat the cold (freshly charged) oven. After the process of coking is finished the doors at both ends of the respective ovens (retort) are lifted by means of the windlasses afore-mentioned, the coke pushing machine now pushes the whole cake of coke out of the retort, landing it clear of the ovens on the discharge side (6), where it is water-cooled.

As soon as the coke is pushed out by the ram of the coke pushing machine, the oven doors are re-closed and sealed air tight with ordinary clay; the coal to be charged is now dumped into the oven through the charging holes 15, 15, 15, and levelled in the usual way.

The main advantages of these retort ovens, without saving of tar and ammonia, over the bee-hive oven are as follows:—

1st. A larger yield, 12 to 15 per cent at least.

2nd. Considerable lower cost of coke-making (labor—expenses).

3rd. All coke produced is large and strong, there is less than 3 per cent. of fine coke—braize.

4th. Large production per oven.

5th. Fewer repairs, etc.

6th. One important advantage of the retort oven is that owing to the high temperature carried and to the high and narrow column of coal, (6 feet), inferior coking coals can be successfully coked, also a mixture of coking and non-coking coal.

The ovens of the New Glasgow Company are the first retort coke ovens working successfully on this side of the water.

On the continent of Europe the retort oven has entirely replaced the bee-hive oven, and England is at present building large numbers of retort ovens to replace bee-hives; in America also competition will no doubt force the coke producers soon to adopt the retort oven, either with or without saving of the by-products.

Ore Deposits.—As is well known, the ore occurs at the junction of the Carboniferous and Silurian formations, in bodies of large size, which are opened at different points in the East River, extending over a distance of five miles. The ore is won by shafts or inclines, according as the pitch of the ore is more or less inclined. During the past year the ore used has come principally from the McDonald and Grant mines. Tramways, as shown in plan, extend from the mines to the washer. The principal impurity in this ore is clay, which is easily and cheaply separated by washing. The washer used is a section of a conical revolving drum with inclined blades or fins on the inside, which work the ore from the large to the small end, while the water (from a Cameron pump) enters at the small end of the drum, washing the clay from the ore which it meets in its descent, and discharging it in spouts, which lead the settling pond. The ore is discharged from the small end of the drum into a bin, and from thence into the cars.

The Cameron mine is situated about half a mile north

New Glasgow Iron, Coal & Railway Company, Ltd.

from the washer, and has not been worked so far, being kept as a reserve.

There has also been used in the furnace during the last few months a red hematite, which occurs in the Lower Silurian formation as bedded deposits. This is the same class of ore as is mined at Torbrook, Annapolis Co. It occurs in large beds in Pictou Co. and also at Arisaig, in Antigonish Co.

All the ore obtained so far has been from open cuts, no systematic mining having been commenced on this red ore. The amount of ore mined is about 4,000 tons per month, including both brown and red hematites.

Mining Machinery.

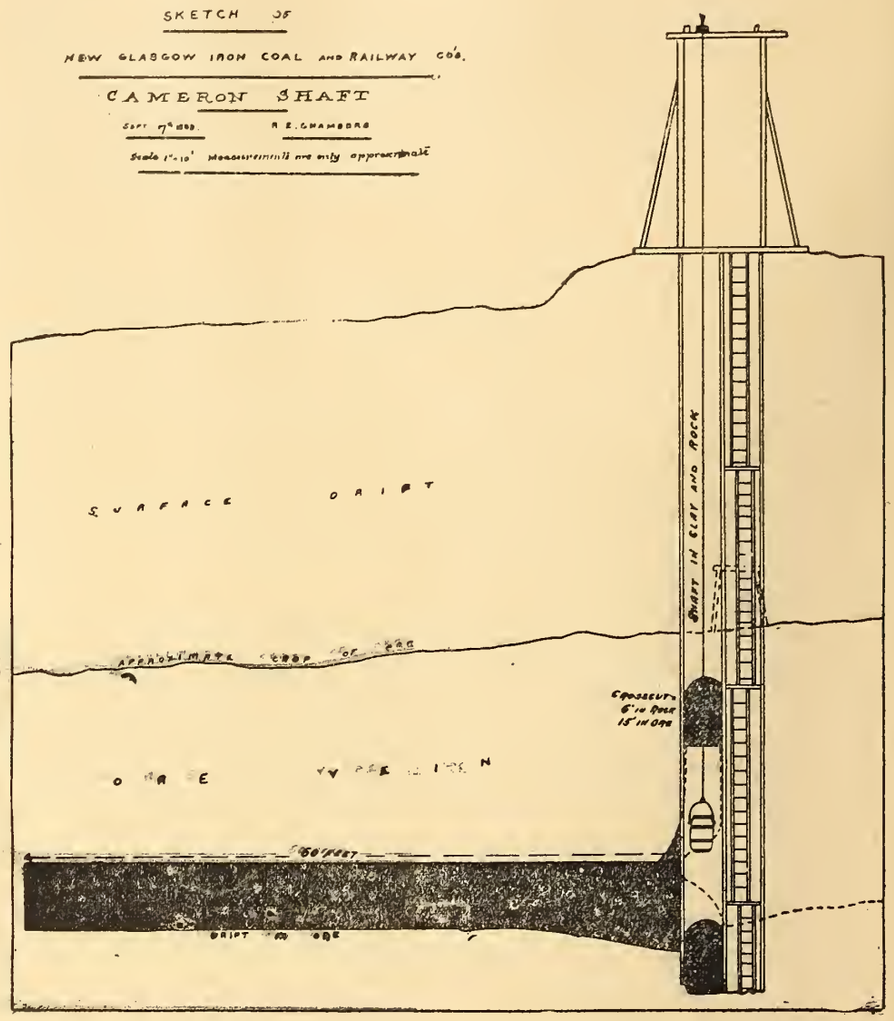
The machinery at the mines comprises:—

Grant Mine.—One upright boiler of 25 h. p.; one double cylinder; hoisting engines having cylinders 8 x 10; one Cameron sinking pump, 9 x 8 x 4, etc.

McDonald Mine—On Slope—One 60 h. p. locomotive boiler, and one 50 h.p. double cylinder Lidgerwood hoisting engine. On Shaft—One 60 h.p. hoisting engine (Jenckes) and one 12 x 11 x 5 Cameron steam pump.

Fraser Mine.—One 30 and one 15 h. p. upright boiler, one 16 h.p. double cylinder hoisting engine, one 8 x 6 x 4 Cameron pump, and one 7 x 8 x 4 duplex Worthington pump; also ore washer, operated by one 100 h.p. upright boiler, and one 15 h.p. single cylinder stationery engine; Cameron pump 10 x 8 x 4.

The prospecting plant includes a 20 h.p. locomotive portable boiler and hoist.

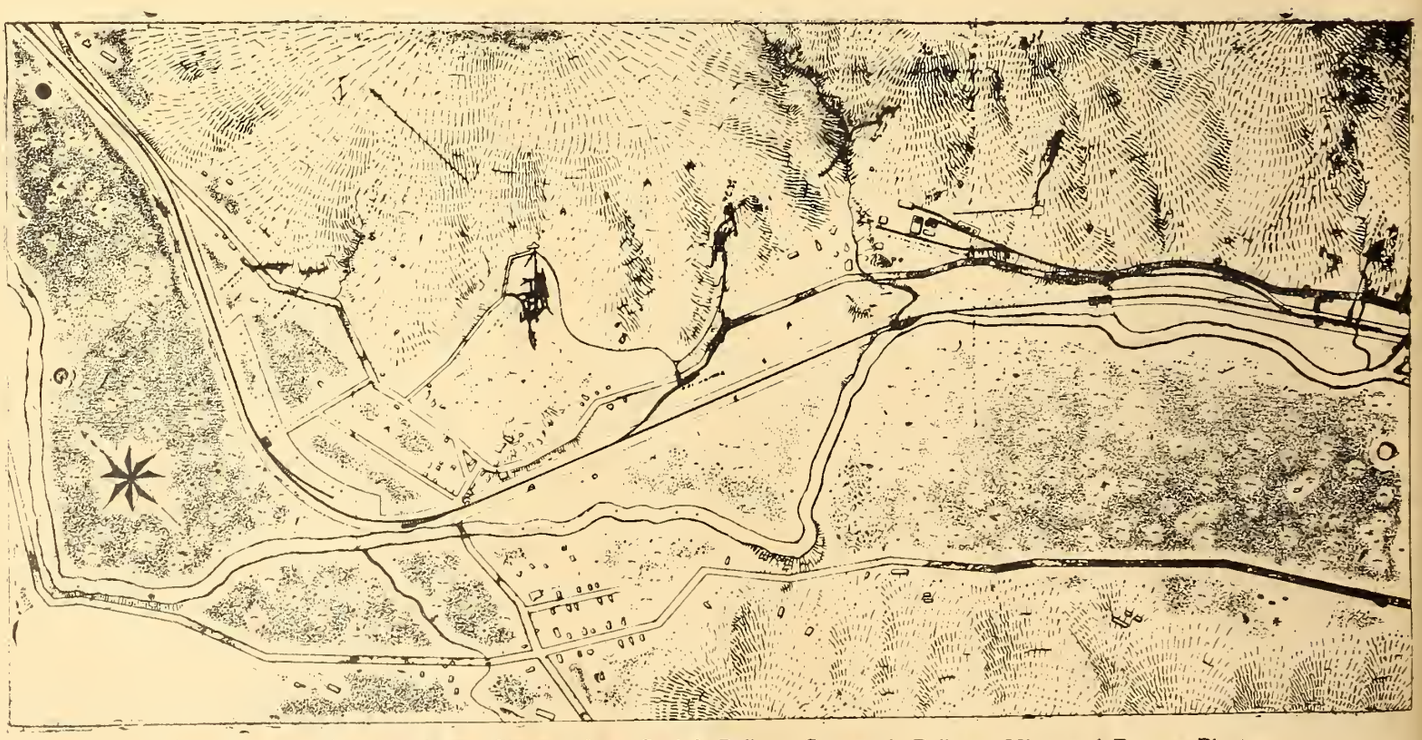


The Detonation of High Explosives by Percussion.

Mr. W. J. Orsman, in the *Transactions* of the Federated Institution of Mining Engineers, vol. iii., page 574-579, has made some experiments to determine the effect of percussion in various explosives, and the difference between detonation and the explosion produced by percussion. Explosives may be arranged in the following three classes, the first requiring a detonator with 15 grains of fulminate of mercury and the third needing 30 grains:

1. Nitro-glycerine compounds, comprising dynamite, gelignite, blasting gelatine, carbonite, etc.
2. Nitro-cotton, including cotton powder, tonite, etc.
3. Nitrate of ammonia powders, including roburite, ammonite, etc.

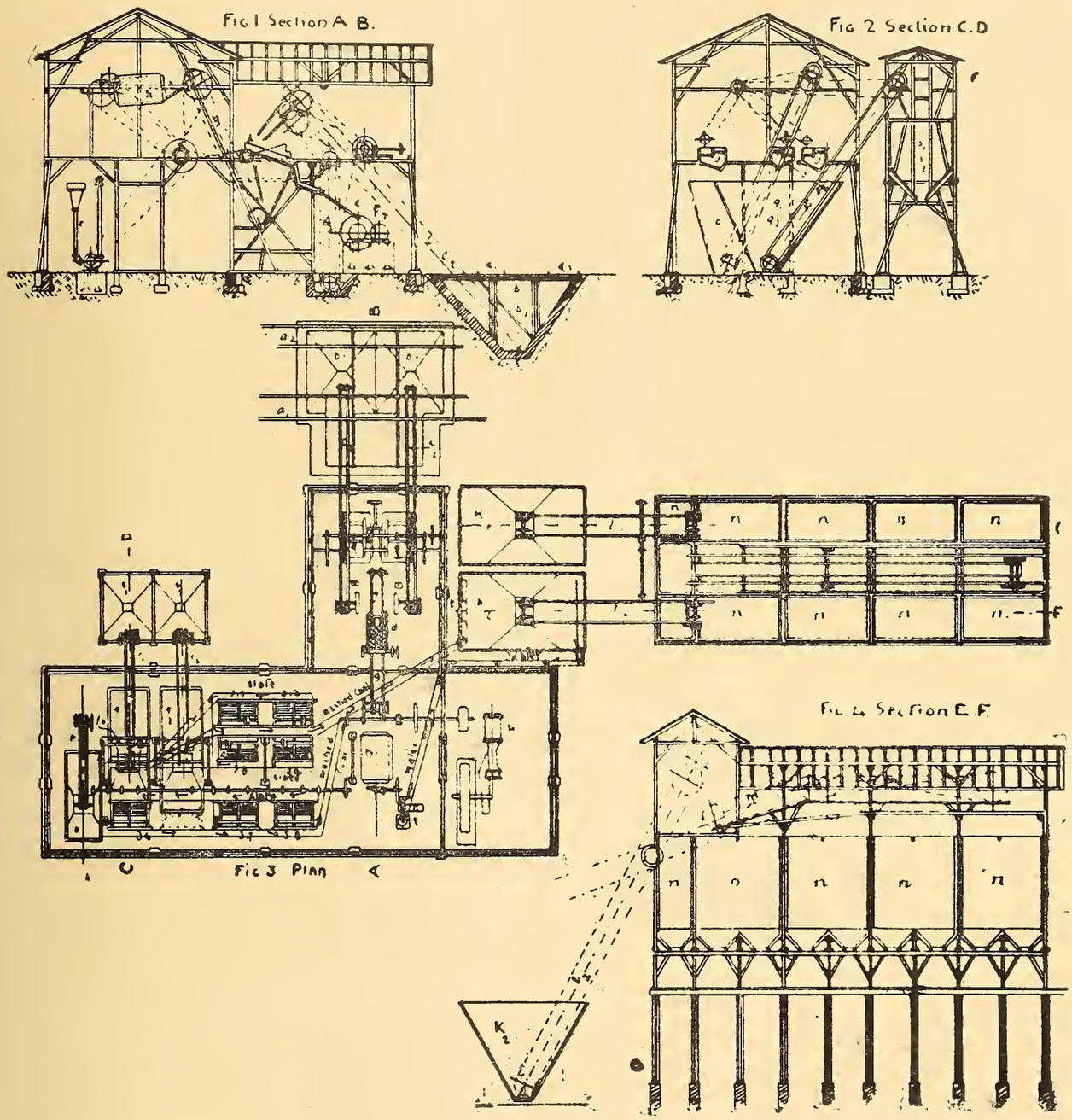
Percussion experiments with a falling weight of 59 lbs. pointed at the lower end, exploded substances of the first class with a fall of 6 to 12 inches, of the second class with 2 to 3 feet, but with falls up to 40 feet the latter class explosives were not exploded but only decomposed locally. The explosion of roburite by a detonator did not ignite gunpowder.



Sketch showing location of New Glasgow Iron, Coal & Railway Company's Railway, Mines and Furnace Plant.

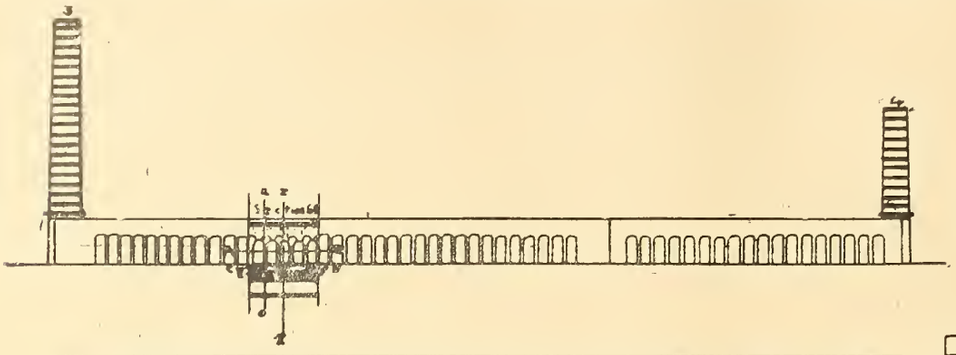
New Glasgow Iron, Coal and Railway Company, Ltd.

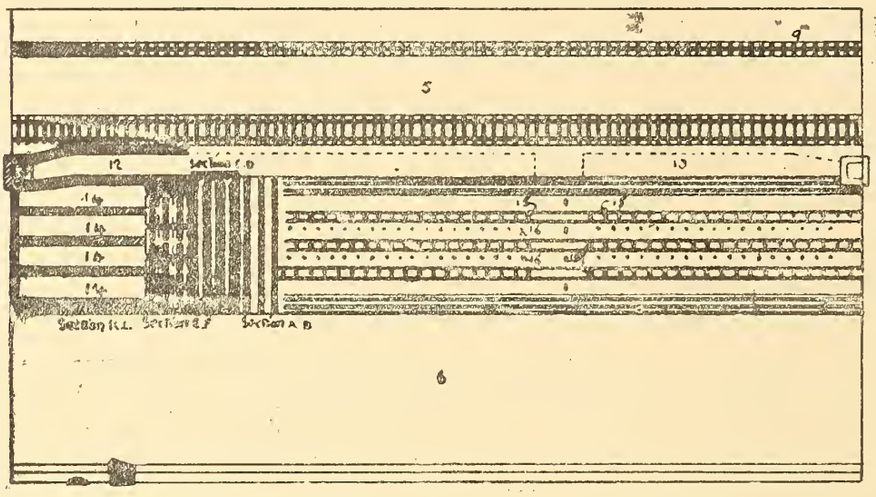
General Plan & Description
of
Coal Washing Plant of the New Glasgow Iron, Coal & Railway Co. Ltd
Ferrona, N. S. Canada.



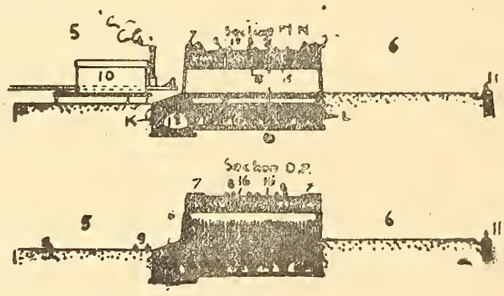
*A*1-*A*2—Railroad Tracks for arrival of coal from different mines.
*B*1-*B*2—Double Dumping Pit, so arranged that each kind of coal may he dumped separately.
*C*1-*C*2—Bucket Elevator to take coal from B1 and B2 to Shaking Table (Screen D).
D—Shaking Table Screen, with double eccentric motion, imitating hand screening as much as possible. The mesh of perforated screen plate is ⅜ inches.
*E*1-*E*2—Crushing Rolls, to crush the coal too large to go through the Shaking Table (Screen D).
F—Bucket Elevator, to elevate the crushed coal again to Shaking Table (Screen D).
G—Bucket Elevator, to take the coal which passes through the Shaking Table (Screen D) to
H—Separating Drum, which separates the coal into three sizes, 0 to ⅛ in., ⅛ in. to ¼ in., ¼ in. to ⅜ in.
J 1-*J* 8—Two-Compartment Fine Corn Coal Jigs. The coal chutes from the Separating Drum H to these Jigs. The washed coal from the Jigs flows into
*K*2—Elevator Boot, and is taken from there to top of Storage Tower by means of
*L*2—Perforated Bucket Elevator, which discharges the coal on
M—Conveyor Band, which distributes the coal into
N—Compartments of the Coal Storage Tower.
The Jigs shown in dotted lines and
*K*1—Elevator Boot,
*L*1—Perforated Bucket Elevators, are contemplated to be put in if a larger capacity is required.
The Slate from Jigs *J*1 to *J*8 is discharged into
*Q*1—Elevator Boot, and is taken by
*R*1—Perforated Bucket Elevator into
*S*1—Slate Storage Tower.
*J*5—Jig can be arranged to re-wash the Slate if necessary. In case the slate is to be re-washed it is discharged into
O—Elevator Boot in place of *Q*1, and is taken to Jig *J*5 by means of
P—Perforated Bucket Elevator. The Jig *J*5 discharges the final Slate into the Elevator Boot *Q*1, from whence it is conveyed by means of Perforated Bucket Elevator R, to Slate Storage Tower S1.
The coal obtained from the re-washed product can either go with the washed coal to Elevator Boot K2, or be discharged into
*Q*2—Elevator Boot, and be taken by
*R*2—Perforated Bucket Elevator t
*S*2—Storage Tower, if the percentage of ash is too high for coking purposes.
T—Centrifugal Pump, to which all the water returns from the Elevator Boots, and is used over again.
U—Steam Engine.
If the Slate is not to be re-washed the Jig *J*5 can be used for washing coal.

New Glasgow Iron, Coal & Railway Company, Ltd.

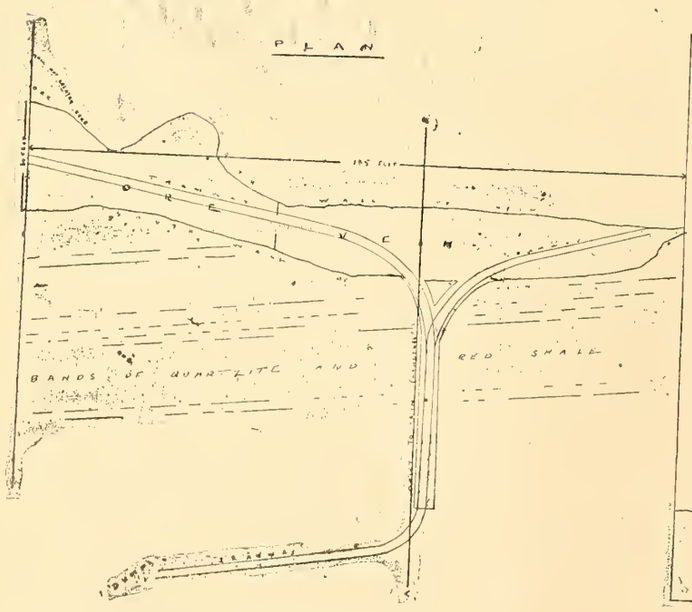


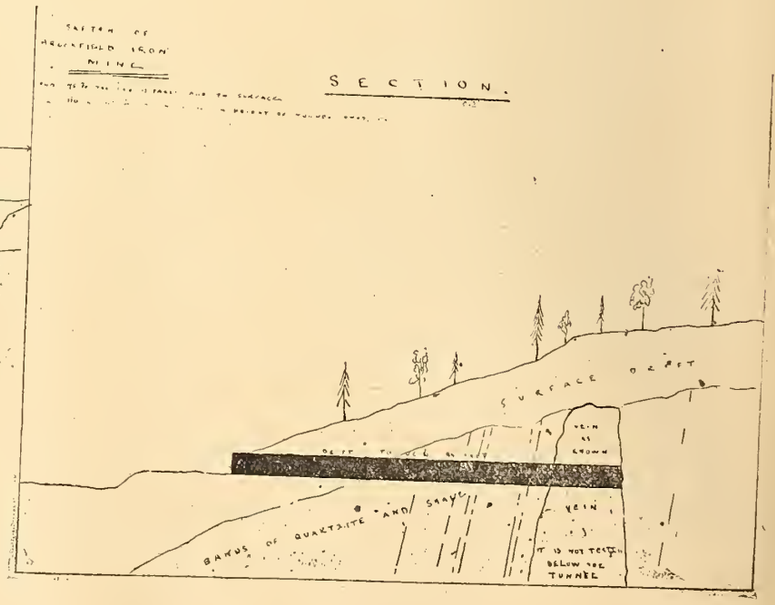


1	Battery of 36 Retort Coke Ovens
2	" " 18 " " "
3	Chimney for #1
4	" " #2
5	Side of Coke Pushing Machine
6	Coke Discharge Side
7	Tracks for windlass for raising doors of Ovens
8	" " Larries " charging Coal
9	" " Coke pushing Machine
10	Coke Pushing Machine
11	Water Supply
12	Main Gas Flue of #1
13	" " " " #2
14	Air Flues
15	Charging Holes
16	Air



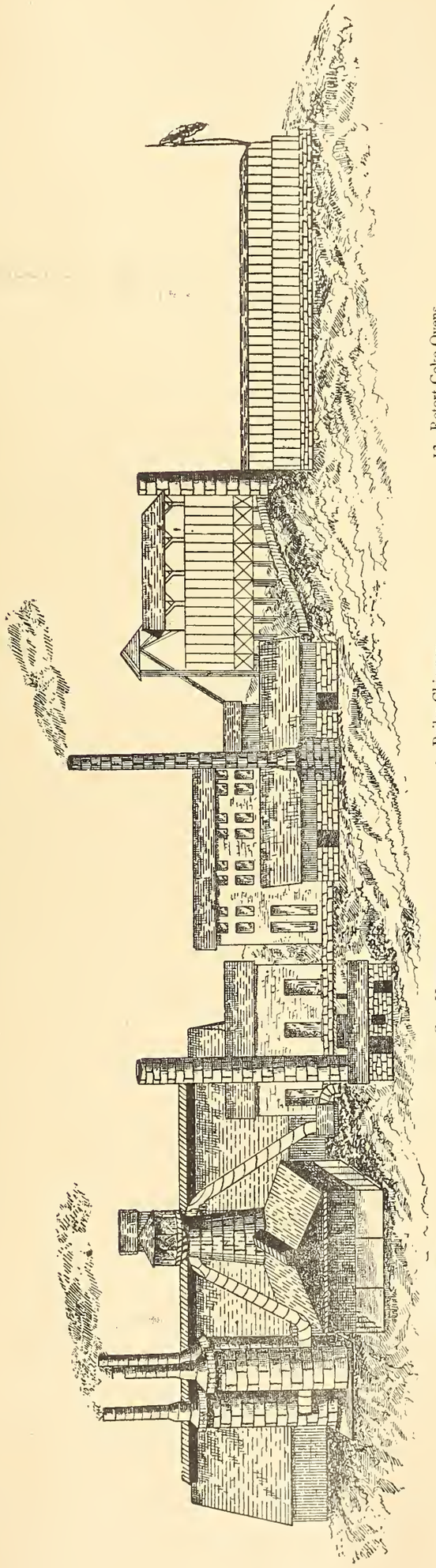
Double Battery of 54 Retort Coke Ovens,
Bernard's System.
of the New Glasgow Iron, Coal & Railway Co L[td]
Ferrona, N.S., Canada.





New Glasgow Iron, Coal & Railway Company, Ltd.

Exterior View of Furnace Plant at Ferrona, N. S.



1. Blast Furnace.
2. Blast Tower.
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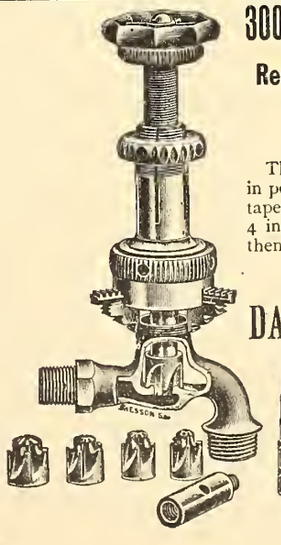

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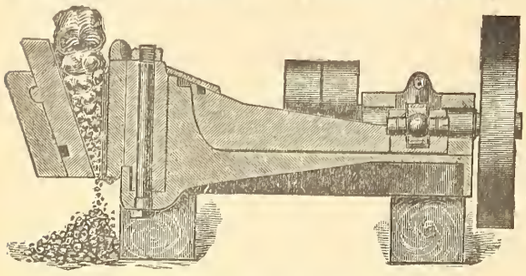

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The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'case of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. & Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

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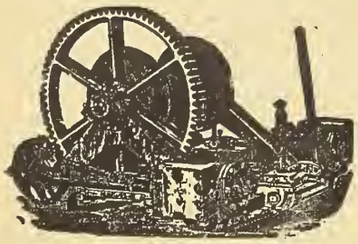

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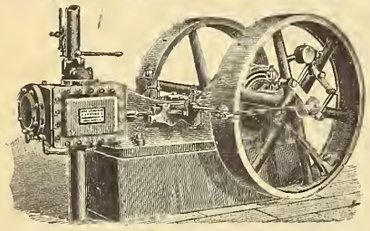

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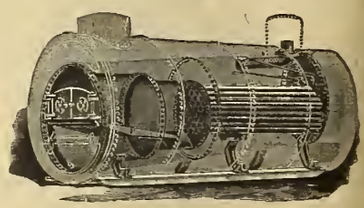

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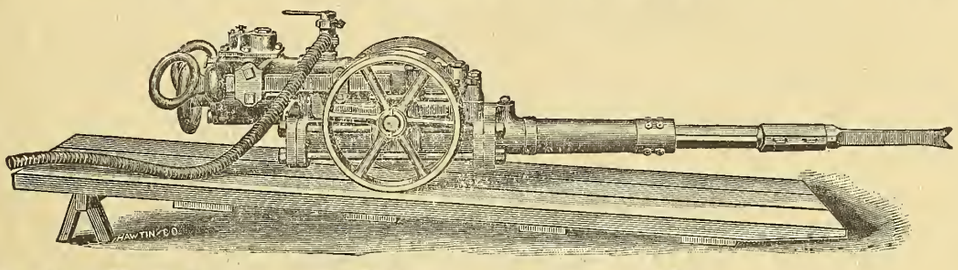

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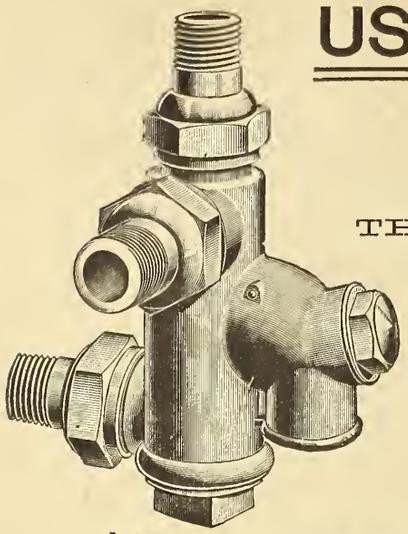

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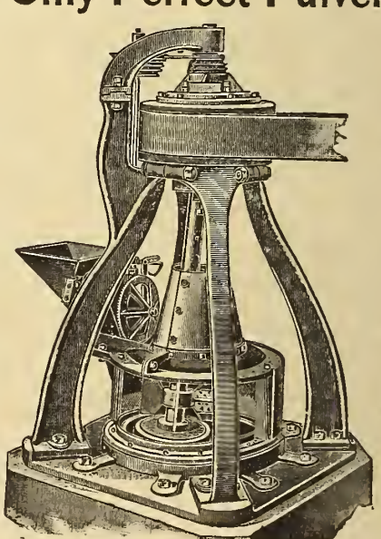

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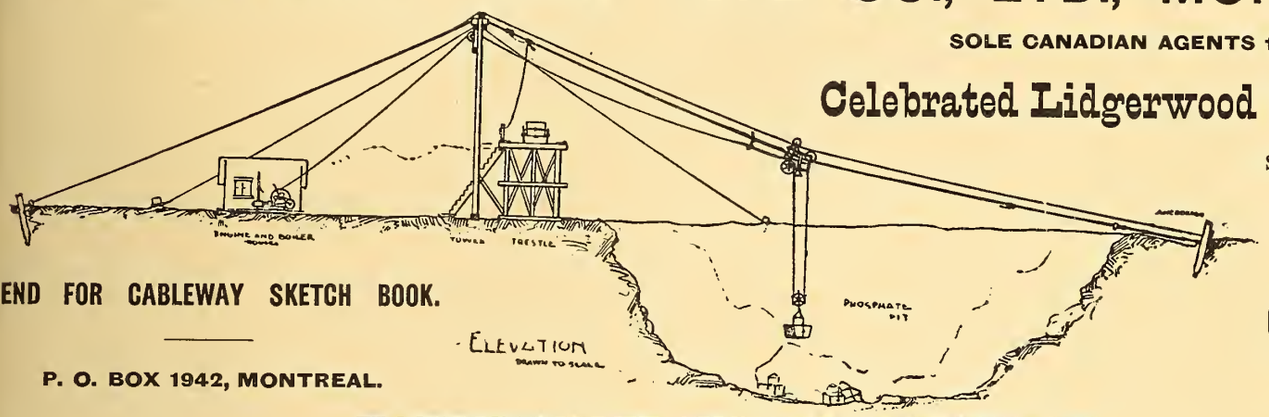

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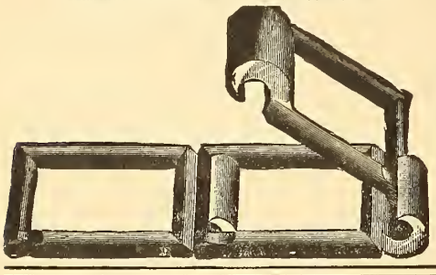

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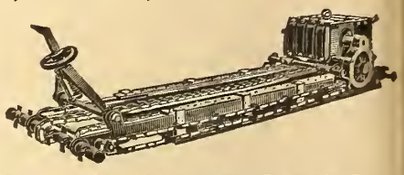

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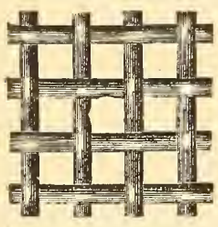

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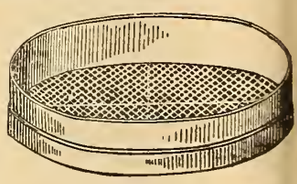

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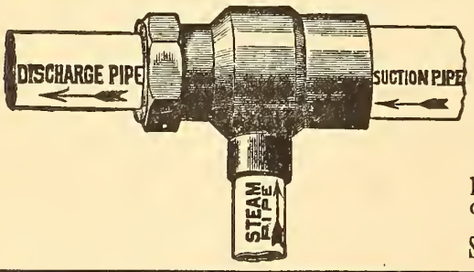

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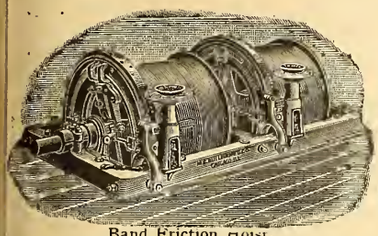

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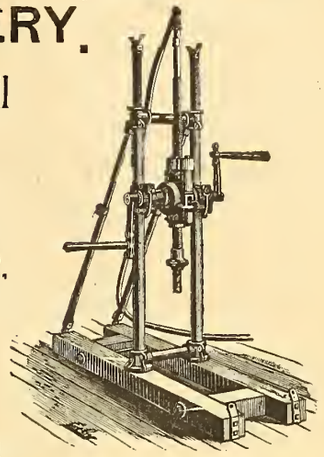

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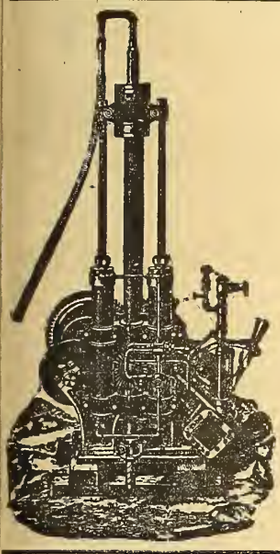
Capacity, 400 ft., 1 3-4" hole, 1 3-16" core.



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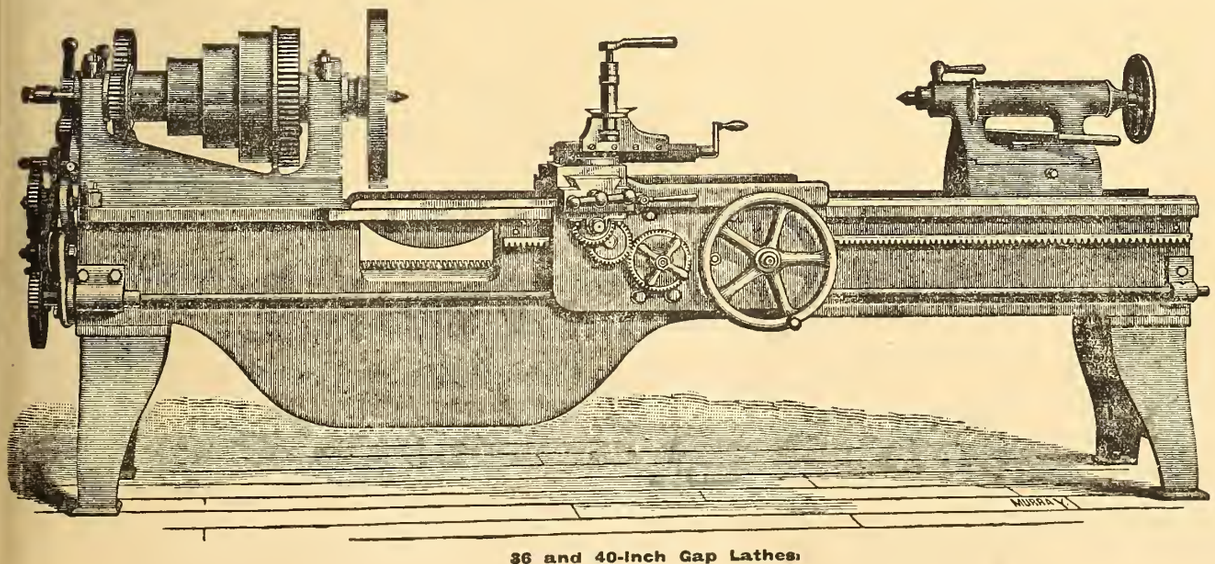

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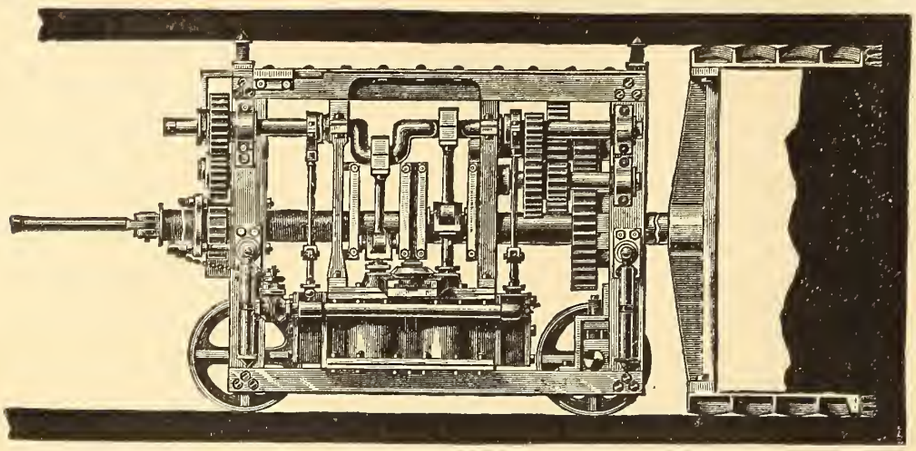

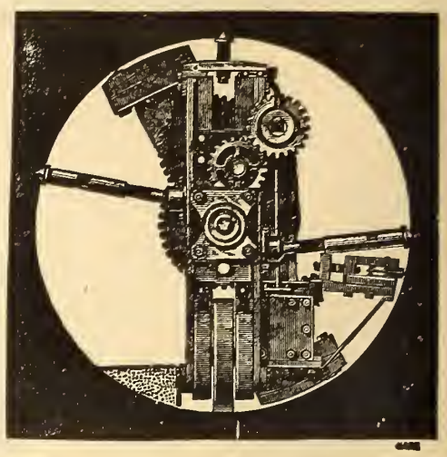

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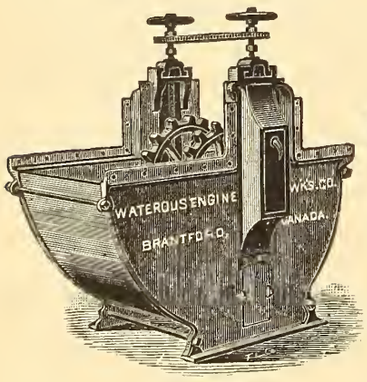

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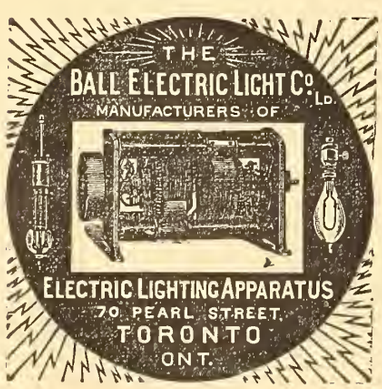

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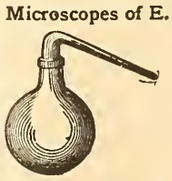

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Locations may be acquired in fee or under leasehold.

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Royalty on ores specified in the Act, 2 to 3 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892) until fifteen years in the case of an original discovery of ore or mineral.

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Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

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PROVINCE OF NEW BRUNSWICK.

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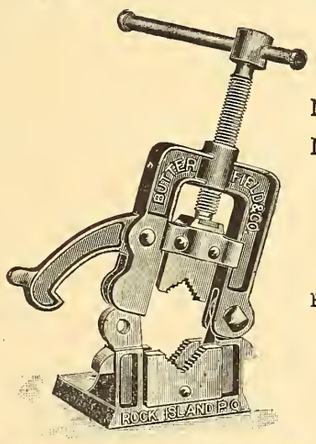

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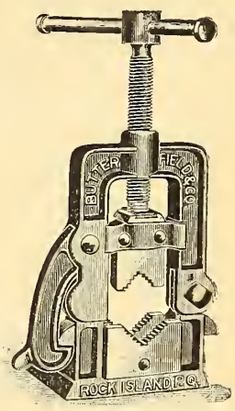

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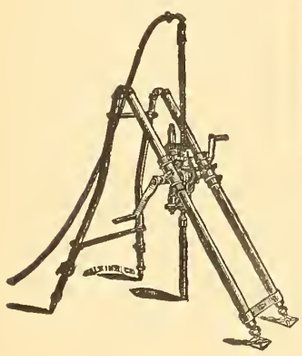

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Capacity—300 ft. depth.

Removes $1\frac{3}{8}$ inches solid core.

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The Diamond Drill brings to the surface a **solid core** of rock and mineral to any depth, showing with **perfect accuracy** the nature, quality and extent of the ore-bearing strata, and with great **saving in time and expense** over any other method.

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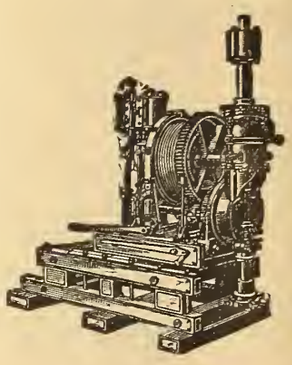

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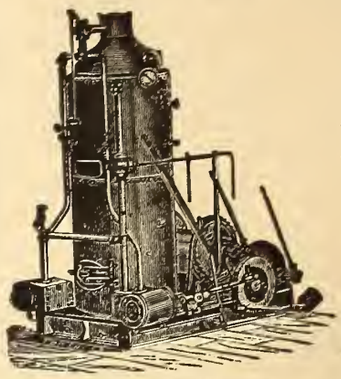

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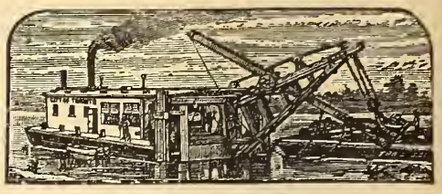

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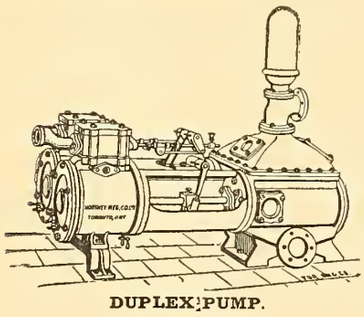

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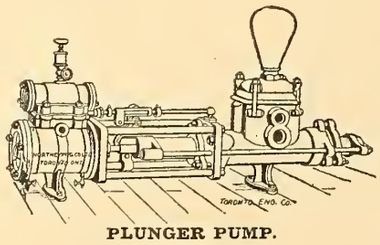

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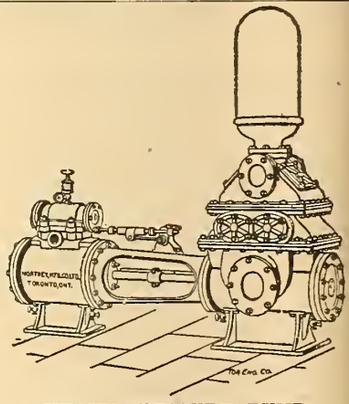

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OFFICES:
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THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEBEC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The Protection of Forests against Fire.

This subject is of no light importance to the mining interests of the country, whether the forest be looked upon as a storehouse of fuel for operating mining machinery, or for metallurgical use, or for timber for protecting excavations, and for mining structures and dwellings. The use of timber for all of these purposes in active mining operations is enormous, and especially so in the manufacture of charcoal. The destruction of the forest through recklessness has been so great in many localities as to render it impossible to entertain the project of smelting valuable ores found there, and along with this the cost of engine fuel, mining timber and lumber is so largely increased by the expensive haul over a rough and difficult country, that many ore properties, which in the presence of such a natural supply as existed thirty years ago would have been extremely valuable, are now actually worthless. The estimate of the loss is easily computed thus: Given a fairly valuable ore and flux at any point whence pig iron may be easily shipped, every well wooded acre of land will give fuel worth $100. An annual output of ten millions of dollars worth of charcoal iron is the approximately correct value of the American production, and the same figure stands for the Swedish production. When due regard is given to the valuable industries which use this production in the raw material of various manufactures, some conception may be attained of the value of forest fuel. There would be little use to cull from the Trade Reports the figures which express our yearly tribute to the United States for coal if there was any adequate sense in the mind of the people or their law makers of the yearly increasing drain upon the wealth of the country through the criminally wanton destruction of the forest. Here is the coal bill paid to the United States by Ontario and Quebec in the years 1885 to 1892 inclusive, coke excepted:—

	ANTHRACITE COAL.	BITUMINOUS COAL.
1885	$3,644,264	$3,014,693
1886	3,777,804	2,414,267
1887	3,643,202	2,980,664
1888	5,021,985	3,421,363
1889	4,872,533	3,061,377
1890	4,261,810	3,339,520
1891	4,893,225	4,146,054
1892	5,289,992	4,031,611
Totals ...	$35,394,915	$26,409,549

or nearly sixty-two millions of dollars in eight years!

"The whole fire question in the United States," said Mr. Fenrow, Chief of the American Department of Forestry, in a public address, "is one of bad habits and loose morals." These terms sound like a strong indictment, but they do not sufficiently probe the seat of disease in the Canadian conscience. The instinct of the criminal, the *animus furandi*, marks the people of this country in their relations to forest administration. The charge can be brought home to Crown Lands Departments, lumbermen, farmers, municipal councillors, judges on the bench, and jurors. Senator McLaren had to contest step by step to the Supreme Court his claim that a railway company should bonnet their locomotives and use the best appliances for arresting sparks from passing through the smokestacks. In Phelps vs. The Canada Southren Railway Co., Judge Henry dissented from the ruling of the Supreme Court in favor of the plaintiff on the ground that a second fire caused by sparks from a fire kindled on the railway company's property by sparks from their own locomotive, is a damage too remote to be a tort in law. The railway companies though candidates for all kinds of municipal and government bounties, make no hesitation in fighting at every point their liability for damages caused by fires from their locomotives, while the fact is that their roadways are for many years after construction tinder beds of old stumps and rotting timber, the removal of which by contractors should be insisted upon before the payment of one cent of bonus. The government has failed to protect the property of which it is the custodian, and has suffered the railways to do incalculable damage in this way, or in the case of land held under timber license, has in years gone by shielded itself behind the wretched excuse that the protection of their limits was the business of the lumbermen. Now the expense of fire guardians is divided between the lumbermen and the government.

A small portion of the crime of which the wide spread brulées are the enduring record is the work of the railways. To the operation of the Free Grants Act must be ascribed the destruction of more timber, the waste of more public money, the loss of more individual capital and years of fruitless toil, than has attended any other ill starred enterprise in the Province of Ontario. The settlers have been distributed over an immense territory, along great stretches of ill-made roads. The latter have been of enormous value to the lumbermen, and the scanty agriculture which wins hay and oats from the burnt soil is chiefly of value in reducing the expenses of the forest kings. But we look in vain for the advantages which would have come to the settlers from being located in compact bodies on selected tracts where their united labors and taxes would have enabled them to maintain an efficient municipal and educational system. The roads are constant sources of expense; the settlement of the regions opened up makes no progress; the clearing up of tracts of new land, rendered necessary by the rapid wear of soil which has all been burned very deeply, exposes the forest everywhere that it has been penetrated by colonization roads to frequent and disastrous fires. Let a series of Crown Lands reports for 20 years be consulted and evidence will be found that "settlers' fires" have been a known cause of havoc. One will search in vain for a single prosecution, for one practical effort of any effective kind, to stay the destruction. Copies of the Act for the Prevention of Forest Fires have been circulated, but the settlers are perfectly aware of the innocent character of the warning. "What do you do," was asked of a fire guardian, "when you see a fire running from a fallow into the woods. Do you bring the offender to justice?" "No, I get an axe," was the answer, "and help him to put it out. I know better than to quarrel with settlers in the woods."

Strange to say, all efforts to obtain a practical investigation of the ravage going on and the consideration of efforts for its suppresion, have been resisted by the majority in the Provincial Legislature. The Royal Mining Commission of 1890, reported that they "were struck with the appearence of many scenes of desolation where forest fires had swept over wide districts, leaving blackened tree trunks and fire scorched wastes in the place of hills and valleys once covered with timber. The loss to the Province from this cause has reached many millions of dollars within the last thirty years." And again, "the destruction of timber by forest fires is complained of by several witnesses as inimical to the mining industry." A ready facility for acquiring testimony on the subject would be afforded by an Act similar to that for the investigation of accidents by fire to dwelling houses, with this necessary amendment, that as the law, by making the free-grant settler's property

exempt from execution, practically shields him from civil damages, the expense of an inquiry into the origin of a fire should not work the ruin of the injured party by compelling him, as does the Act referred to, to pay the expense of the investigation.

It is the crime of arson to set-on-fire a stack of hay, and probably such to fire a wood pile, but it has never been made such a crime in this country to set fire to square leagues of forest. It is an indictable offence when one, by such negligence as shows him to be reckless or wantonly regardless of consequences, sets fire to any forest or tree on this Crown domain or on private property, *on any creek or river or rollway beach or wharf*, so that the same is injured or distroyed. The words in italics taken from section 486 of Sir John Thompson's Criminal Code, seem to limit the range of the offence and to afford to the indigenous tramp or reckless bushwhacker the opportunity to kindle a flame regardless of legal consequences, if he will only keep away from the watercourses. And a further degree of protection seems to be afforded the wrong-doer in a case where the property first destroyed is his own, provided the wrong done was without intent to defraud.

The destruction of the forest by settlers' fires beyond the limits required for tillage, is more than reckless waste. It is crime. It is an invasion of the providential natural economy of the territory the nation is permitted to occupy. It injuriously interferes with terrestrial evaporation,—part of the providential climatic law: it interferes with the distribution of the rainfall, with the preservation of fertility in the soil for the food of future generations; and in view of these copious wrongs is a crime against the Divine Providence. The social crime is equally of portentous enormity. It robs the country of a source of wealth growing in value with every unit of population and which within itself contains a more independently active increment of growth than any other living principle in the economy of the world we live in. The mineral wealth of the country grows not,—only the means for converting it into wealth. The treeless soil is valueless without labor. But the tree wins from air and rain and sun a yearly tribute of nourishment which the falling leaf gives to the soil while the yearly ring of wood-growth is enclosed within the bark for the future use of man.

The operation of the system of fire-rangers, paid in part by the Governments in part by the limit owners, is credited with a greater claim for efficiency than it is entitled to. It makes no provision for dealing with the wanton destruction of timber by the settlers themselves, who often look upon a fire which consumes their wood standing as a ready means for preparing the way for clearing and "getting the land into hay." Within a few years past a correspondent of the *Globe* called attention to the danger to forests in a remote part of the Nipissing district by giving location tickets for the settlement of land wholly unfit for cultivation. The worst fires, as a rule, are not those which break out on well timbered limits, but those which occur when a limit has been worked over a number of years. Lumbermen have been known to retain in their possesion when they have had no desire to cut these limits with only a residuum of blasted trees, and instances are not wanting where they have refused to sell such to settlers or jobbers, preferring to see the limit remain a ready victim for the lightning bolt or the wind-wafted spark from a clearing, than to allow any lumbering operations which might reduce the risk of fire.

Mr. Fernow, in his report for the year 1892, presents the draft of a measure for the protection of forest property, worthy, in its main features, of the consideration of legislators in Ontario and Quebec. It proposes the appointment of a commissioner to organize and supervise, and be responsible, under the provisions of the Act for the protection of forest property against fire Then follow clauses for the organization of fire service, for the creation of a fire indemnity fund, and for legal proceedings for the prosecution of incendiaries. It suffices here to draw attention to these suggestions for legislation. In many ways the people of the United States are helping the cause of forest protection by the organization of state forestry associations, among which must be noted the Pennsylvania Forestry Association, under the presidency of John Birkinbine, C.E. Its monthly bulletin, *Forest Leaves*, deserves widespread recognition. Chief of all, the labors of the former Secretary of Agriculture, and his successor, Hon. Mr. Morton, the eminent founder of the American Arbor day, and also of our own, and the profound studies and learned discussions of Mr. B. E. Fernow, an accomplished authority on all matters relating to forestry, have advanced the cause of forest protection to that point where its demands now meet with general accord. In Ontario, Mr. Phipps, as Clerk of Forestry, has issued many reports on the subject of planting trees, and on foreign methods of forest management, which have been of great interest to the public. His efforts, however, will only make the indictment stronger against the persons in power, who are responsible for the protection of the greatest endowment the country has, if speedy measures are not devised for the protection of private and public forests from fire.

The forest region is without any system of police, and probably needs none for any other than the purpose mentioned. Private injuries on this score abound, but the injured are too poor "to take the law" on those who are so mean as to break it. Municipal regulation of the season for firing log heaps is allowed, but the history of the country too well establishes that municipal prevention of wrong in this matter, where every municipal officer is more likely than not to excuse the wrong, is an utter farce. The popular conscience has been debauched by the universal incendiarism. No amount of warning or expostulations will be of any avail. Nothing but a vigorous policy will serve to protect, against this incendiarism, what remains of the great forests of Ontario and Quebec.

The Free Grant townships are 153 in number. In most of these the settlers are so widely scattered as to be unable to give each other any help in fighting fire for the purpose of saving "the bush." It is only when fences, crops or buildings are in danger that neighbourly help comes from far and wide. There is no reason, from the settler's point of view, why he should make the least effort to prevent fire from spreading beyond his clearing. As a conseqnence settlers' fires often run through hemlock, spruce and swamp timber in which the lumbermen have no interest, and for the preservation of which the present system of fire-ranging makes no provision. The hardwood timber is seriously damaged by the destruction of the soil and this means a greater loss to the country than the mere value of the hardwood itself. If the soil were left intact the indigenous growth would in two generations replace the average loss.

The subject invites the interest of the journalists of the country, without whose aid it is useless to look for any remedy in this matter. It must be remembered that the forest interest elects no representative to the legislature. Lumbermen, who make the largest fortunes in the community, when they retire from business invest in Virginia wild lands, Utah silver mines and Texas cattle ranches, or, in their wiser moments, in bank stocks. Not one of our forest kings has ever said in public one word in behalf of all that is comprehended under the word "forestry." The Crown Lands Departments are administered solely with a view to present revenue. The backwoods portions of the constituencies, with the exception of the Ontario districts of Nipissing, Algoma, Thunder Bay and Rainy River, are convenient fields for the exercise of lumbermen's patronage, and the patronage of the local member in securing government grants for poor schools and colonization roads, and all with an eye to—votes. That administration of Crown Lands in any province suits best the popular opinion which averts for the time the Canadian farmers' nightmare—direct taxation. The tax in the future of increased yearly subventions to the United States for fuel and of increased cost of building timber, deserves consideration, because the ratio of increase is amazingly rapid and likely to become ere many years go by the most burdensome of all charges on the industry of the country.

EN PASSANT.

A rather good story is going the rounds, which illustrates to a T, the penny wise and pound foolish policy that not infrequently characterizes the operations of our Geological Survey. While the Department was investigating the nickel resources of the Sudbury district, one of the largest operators, whose works are ordinarily a sealed letter, took occasion to show a great deal of kindness and courtesy to the officers in charge of the work. Every facility was afforded to inspect the mines and works, and the manager

went out of his way to obtain and give much valuable information respecting the industry. Sometime afterwards he had occasion to use a map of the district, and writing to the Survey, for whom he had done so much, was promptly informed that *on the receipt of ten cents* he could have the map. Such crass stupidity naturally bore fruit. When the Survey desired this Company's exhibit—by the way one of the finest to be seen at Chicago—for its collection at the World's Fair, they were very properly refused, and instead the exhibits were handed over to Mr. Boyle, the Ontario Commissioner. *Sic vos non vobis.*

Writing of the Survey reminds us that a much needed catalogue of the mineral exhibits in the museum at Ottawa, has just been issued. It has been carefully compiled in handy form by Mr. G. C. Hoffman, the curator. This, the latest work issued by the Department, will be found of great service as a reference to all interested in our mineral resources. The only wonder is that the Director should have been so tardy with its publication.

As showing the extent of popular sympathy for distress caused by colliery accidents in England, it may be stated that during the last thirty years there has been raised at the Mansion House, London, the noble sum of £117,025. At the same time these figures must not be taken as representing the full amount of financial help obtained through the Mansion House. There have been many instances in which, while the Lord Mayor's fund has been a comparative failure, the total sum raised has been sufficient for its purpose, and it is impossible to estimate the effect upon public charity of an appeal from the Chief Magistrate of the City of London.

The statistics just published by the American Iron and Steel Association show that the total production of pig iron in the United States in the first six months of 1893 amounted to 4,562,918 tons, against 4,769,683 tons in the corresponding period of 1892, and 4,387,317 tons in the second half of last year. These figures indicate that, compared with the first six months of 1892, the output this year declined by 206,765 tons, or 4·4 per cent., but, compared with the second half of 1892, it increased by 175,601 tons, or 4 per cent. Although the output for the six months ended June 30 was larger than in the preceding six months, it is expected in view of the present depressed condition of the American trade, and the remarkable decline in the output since June, that the total production of pig iron in 1893 will be much less than last year. The rate of production in the various States has undergone several important changes during the past half year. In Pennsylvania the output has increased from 1,976,673 tons in the second half of 1892 to 2,225,962 tons in the first half of the present year; the other increases being 40,000 tons in Maryland, 24,000 tons in Ohio, 16,000 tons in Colorado, 14,000 tons in Kentucky, 11,000 tons in Alabama, and 10,000 tons in Georgia. The principal decline was in the production of Illinois, where it fell from 471,489 tons to 335,771 tons, while in Virginia it decreased by 26,000 tons, in Tennessee by 14,000 tons, and in Michigan by 12,000 tons. The production of Bessemer pig iron in the first half of 1893 was 2,374,890 tons against 2,189,696 tons in the second half of 1892, and 2,254,345 in the first half of that year, the increase being 185,194 tons, or 8·4 per cent., and 120,545 tons, or 5 per cent. respectively. The number of furnaces in blast on June 30 was 225, against 253 on December 31, 1892, and yet the output of the fewer number of furnaces was increased by 175,000 tons. The stock of pig iron shows a large increase, indicative of a worse trade. There were 578,831 tons on June 30 last, against 535,616 tons on December 31, 1892, the increase amounting to 43,215 tons, or 8 per cent. It is intended, with a view of reducing stocks, to blow out more furnaces.

An interesting table has just been submitted to Congress by the director of the United States mint on the moneys of the great nations. The aggregate stock of gold, taking $5 to the pound, is placed at £716,521,000; silver, £808,540,000; uncovered paper currency, £527,174,600. Of the gold and silver France holds the largest amount, £160,000,000 of the former and £140,000,000 of the latter. The United States comes next with £120,800,000 gold and £123,000,000 silver; Great Britain is placed fourth on the list with £110,000,000 gold and £20,000,000 silver; Russia last with only £50,000,000 gold and £12,000,000 silver. In the matter of uncovered paper money South America leads the world with over £120,000,000, Russia is second with £100,000,000, United States third with £82,400,000, and Great Britain last with only £10,000,000. Taking all classes of money, gold, silver and paper, the per capita circulation is given as follows: France, £8 2s.; Cuba, £6 4s.; Netherlands, £5 15s.; Australia, £5 7s.; Belgium, £5 2s; United States, £4 17s. 6d.; United Kingdom, £2 14s.; Russia, £1 8s. 6d.

Coincident with the visit of Dr. E. D. Peters, Jr., the well known copper metallurgist, to Australia, we read of a find of a deposit of nickeliferous pyrrhotite in that country. No information is given as to the probable extent and value of the new discovery.

The success which attended the mining exhibition in London in 1890, has encouraged the members of the Institution of Mining and Metallurgy, and the Mining Section of the London Chamber of Commerce, to take preliminary steps with a view to the holdidg of an International Exhibition of Mining and Metallurgy in London in 1894. We gather that the idea is to endeavor to secure for the coming exhibition the best part of the large collection of minerals, mining machinery and accessories now on view at Chicago. If the proposed Mining Exhibition in London comes off, as it probably will, we trust that Canada will make a special effort to be represented in a manner befitting its great mineral wealth.

Mr. J. S. Jeans, widely known to the engineering world as the able secretary of the Iron and Steel Institute of Great Britain, has resigned his position to assume control of his new monthly, the *Engineering Review*. The first number of Mr. Jean's venture is excellently gotten up, and contains a mass of information of interest to the profession. Considerable space is devoted to summaries of the more notable articles in the leading technical journals and reviews, the data being classified and arranged in such a way as to afford a ready reference. There are also biographical sketches of Sir Henry Bessemer and Robert Forrester Mushet, together with an illustrated supplement of forty pages, giving a description by Mr. Jeans himself of the World's Columbian Exhibition. A highly commendable feature of the new Review is its complete index, after the manner of the *Review of Reviews*, of current engineering literature. The REVIEW extends its congratulations and hearty good wishes for Mr. Jeans' success in his new field of labor.

The *Critic's* latest protege is Mr. C. Ochultree Macdonald, who claims to be a special Canadian correspondent to the *Colliery Guardian*, "with all rights of translation strictly reserved." Perhaps the management at Cow Bay could give the *Critic* a few pointers on the claims of this writer to be considered an authority on the Canadian coal trade. At our last acquaintance Mr. C. Ochiltree Macdonald's specialty was a corner in Canadian spruce gum and maple sugar.

In the Metallurgical Section of the Congress of Mining Engineers, held recently in Chicago, there was an interesting discussion on the paper of Mr. E. C. Potter on American Blast Furnace Practice. Mr. John Birkinbine referred to the fact that the bulk of advancement in blast furnace practice had been within the last 25 or 30 years; that to-day in this country there are active furnaces through all gradations from the cold blast charcoal furnace, with its square stone stack, blast cylinders and water wheel, producing only three or four tons daily, to the modern monster coke furnace, producing 100 times the amount of iron that its ancient prototype made. He credited technical knowledge with much of this advancement, and claimed that the chemist, the manager and the engineer had made the real advance by determining the composition of materials, by studying the reactions in the blast furnace, by applying labor saving machinery to operation, and by using skill in designing and construction. Mr. Birkinbine called attention to the demands for richer ores made by blast furnaces, and the development of the pig iron industry in new districts or sections of the country.

Replying to a question from President Howe, concerning the probability of the long expected

annihilation of the charcoal pig iron industry, Mr. Birkinbine expressed his belief that the United States will continue to produce from 500,000 to 750,000 tons of charcoal iron annually; that the restriction of this branch of industry is due to the difficulty of producing in one locality, or assembling at one point, sufficient fuel to support large plants, and consequently even with cheap fuel, good ores, etc., the charcoal furnaces have the disadvantage of having to divide fixed charges by smaller tonnages.

The metallurgy of lead formed the subject of an interesting paper by Mr. J. B. Hannay, before the last session of the Royal Society of Great Britain. The metallurgy of iron, he said, had obtained complete elucidation during the last twenty years, that of copper was pretty well known, whilst chemists to the Mint—notably Roberts-Austin—had made the metallurgy of the precious metals their special study; but the further great domain of metallurgy, that of lead, was still in the empirical stage. Percy, the greatest authority on metallurgy, admitted, after spending some years at the subject, that the chemical changes involved in the metallurgy of lead were still unexplained. Mr. Hannay proceeded to describe several new volatile compounds of lead, the discovery of which gave the key to the solution of many of the difficulties which had hitherto beset the path of the investigator, and by examining all the furnace reactions of lead compounds in the light of those discoveries he was enabled, he said, for the first time to present a true explanation of the metallurgy of lead founded upon accurate knowledge. By the aid of these discoveries he had devised an entirely new metallurgy of lead founded upon modern methods. The process consisted in passing a stream of air through the lead ore in a Bessemer converter, by which simple means the whole of the ore was converted into pig lead, or litharge, or sulphate of lead, as might be required, thus enabling the manufacturers to make the product bring the best price in the market. The oxidation of the ore supplied all the heat required to conduct the process, so that no fuel was required. The importance of this new process, Mr. Hannay declared, might be judged from the fact that not only was the whole of the lead obtained as finished products without loss, as against a 20 per cent. loss by the old method, but every ounce of silver was separated and collected without any expense, no matter how little silver might be present.

We are indebted to the Scientific Publishing Company, New York, for a copy of Prof. J. F. Kemp's recently published volume on the "Ore Deposits of the United States." In the last forty years enormous developments have been made in new mining districts in the United States, and those which were the chief sources of ores thirty, twenty, or even ten and five years ago, have in instances given place to regions then practically unknown. The older books are thus in large part ancient history. Great advances have also been made in our theoretical knowledge regarding origin and formation. Much that was vain imagining has been replaced by well founded deductions from observation and experiment. Not all the difficulties and uncertainties of exploration and development have been met, nor ever can be, but much greater confidence has been made possible and many unreasonable expectations have become preventable by this fuller knowledge. The present work has been conceived with these important considerations in view. Although its descriptive portion is concerned only with the ore deposits of the United States and Canada, its general and introductory discussion is based upon all the literature of the subject. English, German and French authorities have been studied during the author's residence abroad, as well as American at home. The ore deposits are taken up by metals, in the order shown by the accompanying table of contents. Where, however, two are characteristically associated, as in many deposits of lead and zinc, lead and silver, silver and gold, nickel and cobalt, the two are treated together. Wherever possible the endeavor has been made to pass from the well understood to the more difficult, as is most conspicuously done with iron. Its bog ore deposits are first treated, as the origin of these presents no difficulties, while the magnetic lenses are taken up last, for their method of formation is most obscure of all. So far as possible a definite impression is created by the arrangement of the ore bodies under examples. This term was preferred to that of type, which is used by Von Groddeck, because the arrangement by metals precluded this, and because the relations of ore bodies are often so obscure, poorly defined or ill described, that types cannot be sharply established. This arrangement has been found very serviceable in teaching, as it defines much more sharply in the mind of a student the features on which the instructor would wish to lay especial stress. The treatment is consistently geological and the principals of origin have been made as prominent as possible. The literature is cited in its completeness, but the references have been annotated as to whether they are specially recommended for general consultation, for their historical record, or for complete investigation. In the division of space, the more important regions have been naturally given the greater amount, and the effort has been made to preserve thus a proportion, and not to be too much influenced by purely scientific considerations. At the same time, it is believed that no district of any importance has been overlooked, and that, if it is given but passing mention, the references will place the full literature at command. It is fully realized that there are many important districts, especially in the West, of which our recorded knowledge is limited, and which need study and description. It is hoped that the book may emphasize these, and encourage the study of them. The materials for the book have been assembled for lectures and instruction in economic geology, which have been given by the author during the last seven years, five at Cornell University and two at the School of Mines, Columbia College.

In our next issue the REVIEW will commence publication of a series of illustrated articles on the Canadian mica mining industry, from the pen of Mr. F. Cirkel, M.E., Ottawa.

There has just been published by the Department of Customs a very handily arranged analytical index to the existing Customs Tariff, which our miners and manufacturers will find of the greatest utility. We are glad to note that the Act relating to the free importation of mining machinery is reproduced in the exact language in which it was adopted by Parliament. The words "class *and* kind" instead of "class *or* kind" often proved troublesome to importers when seeking an interpretation of the law at ports of entry.

On Thursday and Friday, 28th and 29th instants, the Mining Society of Nova Scotia will have as its guests the members of the General Mining Association of Quebec in a united meeting at Halifax. Excursions will be made to the gold mines of Waverley and Montagu, and the social features embrace a dinner and an outing on the beautiful harbor at Halifax.

Another big record has been put up by the Witwatersrand mines. The grand figures of 116,884 oz., representing the output of December last, stood unbeaten until May, when the previous record was just topped, the actual total being 116,911 oz. Now we learn that this record has been thrown completely in the shade by the returns for June, which give the magnificent total of 122,907 oz. Only the bare total for June is to hand so far, and we cannot therefore at the moment give any details for that month, but the particulars of the May output have been forwarded by the Chamber of Mines. The returns for the first six months of the current year were as follows: January, 107,474 oz., February, 92,352 oz., March, 111,474 oz., April, 112,053 oz., May, 116,911 oz., and June, 122,907 oz., making a grand total for the first half year of 673,161 oz. The total output for 1892 was 1,210,865 oz., and if the present monthly average is kept up the yield for the current year will top that for 1892 by nearly a quarter of a million ounces. The May returns show that 85,750 oz. gold were obtained from 174,073 tons of stone put through the mills, the average product per ton being 9·85 dwt., that 5,536 oz. were obtained from concentrates, 21,278 oz. from tailings, 171 oz. from alluvial, and 4,174 oz. from other sources, making a grand total of 116,911 oz., worth £411,877. The principal mill yields were as follows:—Robinson Company, 9,062 oz. from 8,042 tons, New Primrose, 4,802 oz. from 12,200 tons, Langlaate Estate, 4,700 oz. from 18,689 tons,

Crown Reef, 4,666 oz. from 10,125 tons, Ferreira, 3,839 oz. from 4,446 tons, Geldenhuis Estate, 3,386 oz. from 4,841 tons, Jumpers, 3,222 oz. from 7,884 tons, Simmer and Jack, 3,142 oz. from 9,506 tons, Durban Roodepoort, 3,030 oz. from 6,531 tons, City and Suburban, 3,002 oz. from 4,259 tons, Meyer and Charlton, 2,938 oz. from 3,025 tons, Wolhuter, 2,724 oz. from 5,192 tons. The highest average yield was 30·03 dwts., obtained by the New Rietfontein Estate from 1,675 tons, New Heriot coming next with 28·61 dwt. from 720 tons, Nigel following with 23·22 dwt. from 2,059 tons, and Robinson being close up with 23·22 dwt. from the very large crushing of 8,042 tons. The lowest average was 4·54 dwt. obtained by the East Roodepoort and the Meyer and Leeb, and among the larger companies, the poorest average shown was that of the Langlaate Estate, with 5·02 dwt. per ton from 18,689 tons. The biggest yield obtained from tailings by any one company was 2,509 oz. by the Durban Roodepoort Company, the New Primrose Company coming next with 2,484 oz., Langlaate Estate following with 2,323 oz., and the Crown Reef Company being fourth with 1,922 oz. The whole of the gold obtained from tailings was recovered by means of the MacArthur-Forrest process.

The British Consul at Wenchow in his last report gives some interesting details respecting the manufacture of steatite or soapstone ornaments in China. The mines are distant 42 miles from Wenchow, and are reached by a boat journey of 35 miles up the river, followed by a land journey of seven miles over rough ground. The hills containing steatite are owned by 20 to 30 families, who in some cases work the mines themselves, in others engage miners to do it on their account. The galleries are driven into the sides of the hills and are often nearly a mile in length. The composition of the hills is soft, and the shafts require to be propped up by supports of timber; for the same reason the floors are full of mire and clay, so that the miners wear special clothing made principally of rhea fibre. They lead a hard life, living in straw huts on the hillside. The stone when first extracted is soft, hardening on exposure to the air. It is brought out of the mine in shovels, and is sold at the pit mouth to the carvers at a uniform price of about ½d. per lb. This would be when the purchaser buys it in gross, without first selecting it in any way. When picked over, the mineral varies very considerably in value—according to the size of the lump, its shape, and, above all, its colors. The colors are given as purple, red, mottled red, black, dark blue, light blue, gray, white, eggshell white, "jade," beeswax, and "frozen." Of these, "jade" (the white variety, not the green), and "frozen" are the most valuable. Indeed, so valuable is the latter that good specimens of it are said to fetch more than real jade itself. The industry finds employment at the present time for some 2,000 miners and carvers. A great impetus was given to it by the opening of Wenchow to foreign trade. Previously to that event the chief purchasers of soapstone were officials and literary men, and the article most often carved was a stamp or seal. When it was discovered that foreigners admired the stone, articles were produced to meet what seemed to be their taste. Such were landscapes in high or low relief, flower vases, plates, card trays, fruit dishes, cups, teapots, and pagodas. If left to his own devices, the native carver proceeds first to examine his stone, much as a cameo cutter would do, to discover how best he can take advantage of its shape and shades of color. There is for this reason room for wide difference in artistic quality, apart altogether from the intrinsic value of the mineral, and carved pieces vary in price from a few cents to $10 and upwards. And among the more purely native articles produced are, besides the seals, writing material, as trays for pens, slabs for rubbing ink, and the like; flower vases, square, round, or hexagonal; boxes for sealing vermilion, incense boxes of all kinds, but chiefly having the character for "long life" in open work on the cover; small sandalwood burners, flower baskets and balls, candlesticks, chessmen (or, as we should regard them, draughts), cups, bowls, and lamps; idols, as the Star of Longevity, the Eight Genii, Goddess of Mercy, lions, monkeys and other animals. Less ambitious workmen content themselves with polishing the stone and cutting in relief certain common emblems, as the sun, moon, clouds, mist, the lute, chessboard, books, scrolls; or the characters for happiness, promotion, old age and posterity.

CORRESPONDENCE.

Use of Peat Fuel in Norway and Sweden.

To the Editor of the Review:

SIR,—From time to time there have occurred in your valuable paper articles about peat fuel, and we have read them with much interest. In the July number, page 112, is a contribution by Mr. Dickson, who says: "It (peat) is extensively used in an air-dried state only in Norway and Sweden for the reduction of iron ores, and some of the finest brands of iron are smelted with peat." The fact is that some *experiments* with *charcoaled* peat were made some 30 years ago at one or two furnaces, but gave not good results; if *air-dried* peat was ever used in a blast furnace there are no records of it. Air-dried peat is, however, used quite extensively by those Swedish iron works who have boys in close proximity, but only for making gas in gas producers and generally together with wood or sawdust; it is giving excellent results used in that way.

In Norway peat cannot be used very extensively for making iron, as that country possesses only *one* iron works and a small one indeed, producing, according to the Official Statistics for 1890 (the latest accessible), only 517 tons of pig iron, 423 tons of bar iron and 268 tons of steel, which is scarcely 1 per cent. of the consumption of the country itself. Many users of Swedish iron on the American continent buy it as *Norway iron*; why it should go under this name any longer we cannot understand. It is about time to give the Swedes the credit for the Swedish iron.

Yours, &c.,

STORA KOPPARBERGS BERGSLAGS AKTIEBOLAG.

FALUN, SWEDEN, Sept. 1st, 1893.

Mining in the Slocan District, B.C.

To the Editor of the Review:

SIR,—I returned a few days ago from a trip through the Slocan district, having visited the principal mines to the south of Kaslo Creek, and was much struck with the healthy appearance of everything.

It is true that there is not very much work being done compared with what everybody last year expected, but when one considers the deadness in all financial matters connected with silver, one cannot help being surprised that the Slocan country is not totally dead too.

With the unsettled value of silver, those monied men who have properties and can afford to wait in expectation of higher prices, are simply doing a little development work, opening up their ledges and generally getting things into shape, so that when the settling of the silver question justifies a larger expenditure of capital they will know where to put it to the best advantage.

On the other hand those owners of properties who have not the money to do any work on their claims but who are waiting for buyers, place a high value on their properties in the full belief of silver coming up again, and buyers are not over anxious to invest in silver properties, however promising the propositions may appear.

Consequently, on the majority of the claims there is not much work being done; but in a few cases the owners have deemed it advisable to commence active operations on their properties.

The Washington has 45 men at work, and is making arrangements to have from 50 to 60 or more at work all the winter, and have already let the contract for the shipping of 100 tons of ore. The Mountain Chief is also actively taking out ore; the Dardanelles having pumped their shaft dry are steadily at work; the Wellington is shipping regularly; the Bonanza King of the noble five group has 120 tons on the way to Kaslo; the Blue Bird is shipping 70 tons; the Idaho has just shipped 20 tons; and other properties are also shipping small quantities.

The waggon road has been completed to Three Forks, and is now being pushed on rapidly to New Denver, a distance of five miles. There are very good trails to all the more important mines, and the transport facilities are as good as they well can be without the railway.

I was much struck with the facility with which the mines may be developed. They are in almost every case high up on steep mountain sides where the opening up of the ore bodies by means of tunnels will be a very simple matter. Tramways and aerial ropeways will take the ores from the tunnel mouth to the railway or waggon road, as the case may be. Water power is plentiful everywhere, and with the facilities electric transmission now gives, power for concentration drills, etc., will be very cheap. I should think there would be a very good opportunity for a general power company for supplying the various groups with power.

It is needless for me to say anything of the ore showings—they have been written and talked of by everybody, suffice it to say that despite all I have heard of their richness and magnitude I was surprised indeed at their appearance.

The quantity and cleanness of the ore is extraordinary, in many cases most of the ore can be shipped after a little hand sorting, though in some of the properties the ore is largely a concentrating ore. There will be, no doubt, severe disappointment in many cases over the want of continuity of the ore bodies, but in so many properties does the veins, now that they have been exposed, show such a steadiness that there can be no doubt whatever that this country is going to be not only a great mining country with very many mines in it, but that the individual mines are going to be large concerns.

There are no drawbacks to this country whatever—the ore is of surpassing richness, the quantity is assured, the facilities for development are of the best, water power is plentiful, the natural contour of the country makes transport the easiest matter when the Crow's Nest Pass railway is built and we can have cheap coke. We are independent of anybody and everything. Silver may go as low as possible, these mines can produce when others have been long closed.

But this has been said often before.

Once let the silver question show signs of settling and the working of these mines will be commenced on a large scale.

As it is, there is a thoroughly wholesome and business-like air about the district. People have stopped talking and have begun to work.

What the country needs now is: the settlement of the silver question, a railway to the mines, a smelter in the neighborhood, and miners, *i.e.*, mining men with experience and brains. Many properties show woefully the lack of ability and experience in their workers.

With regard to new strikes this summer, it has been a puzzler to many outsiders that so few rich strikes have been reported this year.

It is quite true there have been few new discoveries of any importance, but to those who have seen the country this is not surprising.

The country is as a rule well covered with soil and vegetable growth, and it is only where the ledges have been exposed by snow slides, or else high up in bare places, that any discoveries have been made. Last year the country was overrun, and those ledges that were exposed were easily found, the others can only be found after most laborious and careful search.

But there have been new discoveries made, and these of great importance.

Much attention has been paid to the dry ore belt on the north of Carpenter Creek. I have not had the opportunity of visiting this district myself, but from the ores I have seen and the reports I have heard, I am confident that this will develop into a most important district. The ores are chiefly copper ores high in silver.

The Whitewater Basin, just to the north of Kaslo Creek and 18 miles from Kaslo, has been the cause of much excitement and disappointment.

It is the gold district of the Slocan, and there has been much dispute as to whether gold really existed there

in paying quantities. The Basin is a net work of quarry ledges, many barren, some carrying copper and iron pyrites, with traces of gold. Others with gold up to $200 and $300 in hand specimens, and just lately has been found a quarry with free gold easily seen by the eye. This last was looked upon as a "fake," but samples brought down by Mr. Bucke, the assayer, the genuineness of which he vouches for, prove beyond a doubt the existence of a rich quarry. Further developments are eagerly looked for.

Not much has been heard from the Lardo-Duncan country to the north of Kootenay Lake. The Golden Eagle, from which so much was expected last winter, has proved worthless, and beyond one or two really satisfactory finds, not much has been done. This does not show the country to be deficient in mineral; it is very difficult at present to travel in, and not much good prospecting has been done in it. There is still much faith in its future, but so far little has been done.

The St. Mary's country, to the east of Kootenay Lake, has attracted a great deal of attention during the last few weeks. Some very rich finds of copper ores high in silver caused a rush to the country, which resulted in some very fine samples of dry ore being brought in. The samples assayed from 100 ozs. up to the thousands in silver. Some of the last to be brought in was by Mr. McLaren, of Burgess, Ontario, whose sample of his ledge ran 130 ozs. silver and 10% copper. Not enough of the district is known as yet for me to say anything further.

There is still another month of good prospecting weather, and we may look for very important discoveries during that time. The best of the men are now in the hills.

There is much talk about work commencing on the Kaslo-Slocan railway, but beyond the clearing of the right of way for the first five miles and the building of the Kaslo station, nothing has been done.

Very little will be heard about this country until the silver question begins to settle, then *results* will surprise the world.

Meanwhile, now is the time for those who know anything about mines to invest. Cash is very scarce here, and its purchasing power is much greater now than it is likely to be again.

Yours, &c.,

FREIBERG.

CANADIAN COMPANIES.

The Slough Creek Mining Company.—This company, organized about two years ago with headquarters at Tocoma, Washington, and which recently has been opening up alluvial ground at Slough Creek, in the Cariboo district, B.C., has just been registered under the Foreign Companies' Act, B.C.

The Kootenay Mining and Development Co. Ltd., is seeking incorporation. Capital $1,600,000, in shares of $100. Head office, Ainsworth, B. C., with a branch office at Minneapolis, Minn. Directors: Willis Baker, Minneapolis, Joseph B. McArthur and Thos. J. Lendrum, of Ainsworth, B.C. Formed to mine lands and operate mines in the Province of British Columbia. Operations are in the West Kootenai district, B.C.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Newfoundland.

Mr. C. E. Willis, of Halifax, who has been opening asbestos areas at Port au Port Bay in the interests of the Halifax Asbestos Co., has returned and speaks most favorably of the prospect of successful operations. The fibre is of good quality and is reported to be found in quantity.

Nova Scotia.

At the Coxheath copper mine, drifting on the vein has been commenced from the cross cut on the 320 ft. level of shaft No. 2, two power drills being run. There is apparently a swell in the vein on this level, the walls being over 40 ft. apart. Captain Granger reports that he has drifted east 25 ft. on an ore body, which so far fills the entire face of the drift.

Quebec.

Eastern Townships.

Mining operations are being quietly carried on at most of the asbestos mines.

In the Thetford district many of the mines are not working full force, mainly on account of the scarcity of labour.

Messrs. King Bros. are not operating all their pits, but we understand that their mill and crushers are yielding good results.

Nothing is being raised from the pits of the Johnson's Co., operations being confined entirely to their dumps, the product giving good results after being put through the mill. A good quality of No. III., and a fair quantity of No. II. is being won in this way, and it is being disposed of quickly. Extensive shipments of No. I. from stock are also reported.

Mr. A. S. Johnson, managing director of this company, who has been spending some time in the Western States, looking after his interests there, has returned and is now at the mine.

Messrs. Ward Bros. & Co. have not reopened their mine, and it is unlikely that they will do so this year.

The Bell's Asbestos Co. is pushing work energetically at their mine, and a large output is steadily maintained. It is expected that the output will this year be a record one.

The Thetford Mining Company has not done anything in the way of mining, but some needed improvements have been made to the storage capacity, with a view to resumption of work in the future.

The Beaver Asbestos Company, although not working to fully capacity, have a fairly strong force mining in their main pit. A second cable derrick has been added to the plant, which greatly facilitates the handling of material.

The American Asbestos Company are working their mines at Black Lake with their old-time energy, the only drawback being the scarcity of labor. It is gratifying to learn, however, that the depression in the States is acting beneficially, inasmuch as many of the miners who had left when the mines were closed down a year, ago are now returning to the district.

The United Asbestos Company employs, at last report, about 65 men and boys. The management is removing a portion of the dump from what promises to be very productive ground, and tramming it over the mountain. A new cobbing house 40 x 70 has been added to the buildings, together with a couple of Blake crushers, which are worked with a view to the recovery of the lower grade asbestos.

An excellent output is being made by the Anglo-Canadian Asbestos Co.

The Coleraine Mining Co. has started a small force to prospect that portion of their lands formerly operated by what was known as the Black Lake Mining Co.

Ottawa County.

The British Phosphate Co. have cleared their bins and completed their shipments to Europe. It is reported that an action has been entered against the Emerald Mining Co. to recover the loss in the value of the phosphate seized by injunction in the recent suit which the British Phosphate Co. won. The English company claim that the depreciation entailed by the collapse in the market since the injunction, has been considerable.

On the Russell mine, Calumet Island, a larger show of zinc blende has been uncovered than any previously found on this property. It is, we understand, to be tested with the diamond drill.

Mr. A. Benson, manager of the General Phosphate Corporation, shipped this month to Europe, several hundred tons of phosphate, mainly about 70% grade. The consignment was the result of cleaning up the dumps.

We understand that Messrs. Powell and Clemow, Ottawa, have purchased a very promising amber mica property at Aylwin, Que., and a small force is at work opening it up. $15,000 is the figure reported to have been paid. The mica is of large size, and in paying quantities so far as discovered.

Mr. John Poupore has some eleven men working for mica on the Judge lot on the Lievre river.

Messrs. W. A. Jamieson & Co., Ottawa, have 12 men working their Cassidy mica mine in the Township of Hull, and 17 men on the Cascades mine. Fifteen tons were raised last month, at least two of which will cut on an average 4 x 7. The quantity and quality of the mica from these mines, bears a high reputation in the district. A cutting and dressing works, at which a small force is employed, has been opened on Wellington street, Ottawa.

The Lake Gerard Mica Mining System continues to work a reduced force at Lake Gerard and other mines.

The American Mica Co., (Webster & Co.), have shut down production from their Templeton, Sydenham and Perth properties, claiming to have an abundant stock on hand for some time to come.

Beauce District.

A despatch from Quebec announces that the McArthur Bros., of Toronto, have sold a portion of their auriferous mining property in the Beauce gold district to a company of Portland and Boston capitalists for $130,000.

Mr. W. P. Lockwood, who holds a large area of alluvial ground at St. Francis, is also reported to have succeeded in making a deal with wealthy American capitalists. Mr. Dwight Crittenden, a mining expert, has recently been over the ground and has reported very favorably on the property.

Ontario.

The annual meeting of the Ontario Mining Association will be held at Sault Ste. Marie on Wednesday, Oct. 4th, for election of officers and other important business. There should be a full attendance of everyone interested.

An exchange says the big suit of Ritchie vs. The Canadian Copper Co. *et al*, is on again. Judge Burke put H. P. McIntosh upon the stand as a witness on behalf of the defendant and examined him, in chief, about half a day. Then General Butterworth, counsel for the plaintiff, cross examined him for five days and he is not through with him yet.

Belmont Township.

A gold bearing vein on east half lot 19, in 1st concession, Belmont, being the next lot south of the Crawford mine, is being developed by T. D. Ledyard, of Toronto. A shaft has been sunk to the depth of 36 ft., the vein varying from 3 to 6 ft. wide with distinct walls of tolcose schist. The vein matter is composed largely of drusy quartz, from which the pyrites has decomposed, but as the vein descends the sulphurets are becoming more solid. The honeycomb quartz shows a good deal of free gold; the average of six assays made by the Balbach Smelting Co. showed $49 in gold per ton, and an assay of about half a shot bag full of small pieces from all parts of the pit gave $94 in gold to the ton. Different samples of the iron pyrites in which there was no visible gold have been assayed by Elliot & Chambers, of Toronto, showing the following amounts of gold per ton, viz., $117, $193, $195, $198, $318, $338 and $922 per ton. This vein shows itself 150 yards west from the shaft, with the same characteristics. There are numerous other veins upon the property, some of which also show gold.

Messrs. Ricketts & Bank, of New York, have lately been examining the Crawford gold property with a view to its being worked by a New York Company.

Lake of the Woods District.

A despatch from Rat Portage says: The largest gold brick ever produced in this district has just reached here from the Sultana mine. It is a magnificent proof of the richness of our ores, weighing about 100 ounces and valued at nearly $2,000. The brick was obtained from only sixty tons of ore.

There are many rumors in the air in reference to mining properties changing hands. If there is any truth in them, some of the most valuable locations in this district will shortly be operating under new management. Messrs. Barnes and Upton are expected here to-day. It is expected that their presence portends a more active movement in that section of the mining industry in which they are interested. These gentlemen have done much for this district, but have latterly been severely handicapped in their movements by the financial difficulties over the line. The English experts have returned to the old country after subjecting many of the neighboring locations to a severe and critical examination. Fortunately this examination has proved very satisfactory, and it is understood they will be back again within two months. It is in connection with the visit of these gentlemen that the rumored sale of mining property is associated.

The attempts to form a miners' union has not materialized to any appreciable extent. Several meetings have been held, but owing to the lack of interest displayed by the mining men very little was accomplished in the way of organizing. There is no doubt about the unpopularity of the royalty clause, and it will undoubtedly be pushed to the front later on, but the mining men are either too busy to engage in agitation just now or do not care to place themselves in apparent antagonism to the government. The local Conservative association are arranging for some of the leading Opposition members of the legislature to visit the district, when we shall probably hear the question argued from their standpoint.

North-West Territories.

The output of the Canmore coal mines (H. W. McNeil Co., Ltd.), is now 200 tons a day, every pound of which is taken by the C.P.R. At Anthracite they have 5,000 tons stored as a base of supply, all of which will be rescreened when loading on cars. The Canmore coal is now being washed and in future will have no dirt. New stores are being opened by the company at Canmore and Anthracite, and the business is being rapidly extended in all directions.

British Columbia.

Cariboo District.

(From the Colonist.)

There is every likelihood that next spring will bring a great improvement in the mining industry of Upper Cariboo. Two new companies of considerable capital have been formed to work Williams and Willow Creeks. Mr. A. D. Whittier, who has been in England for some time, has succeeded in interesting several British capitalists in Williams Creek, and is now on his way to Barkerville to complete arrangements. It is the intention of this company to work the deep ground of the creek below Barkerville, where were the richest diggings of early days. The ground will be worked by the hydraulic jetting process, having a pressure of 550 feet. The requisite machinery has already been ordered, and will be brought up during the winter.

Mr. Geo. F. Law, of Montreal, representing eastern capitalists, has leased one and a half miles of Willow river. The Government boring machine, that did service a few years ago on the Thompson river, will be used to test the ground, which will eventually be worked in much the same manner as Slough Creek. Operations will be commenced next spring.

Last season Mr. Edward Sheppard, on Sheppard Creek, eight miles northwest of Barkerville, took out $1,200. This year he has been making preparations for working on a more extensive scale. He has brought up a new flume to work the deep ground. There is any amount of good gravel in sight, and Mr. Sheppard now feels certain that fortune is not far away. His brother also has a good prospect on the same creek. The Tenderfoot claim, owned by some Nanaimo parties, adjoins that of Mr. Sheppard. They have run a tunnel for some distance, and are now in good pay gravel at a depth of 28 feet. Next to the last named company a number of Barkerville gentlemen have taken up 2,200 feet of ground. At present this company is paying into the Tenderfoot, in order to have that claim thoroughly prospected.

The Eye-Opener claim on Williams Creek, just opposite Barkerville, has this year shown itself to be a good prospect. Up to the night of the 3rd inst., 128 ounces had been taken out.

On Nelson Creek, the Ah Kow claim (Chinese) made over $6,000 for the work of five men. The Chinese company on Davis Creek have not been so fortunate, although they more than paid expenses, having made a wash-up of over 60 ounces.

The South Wales Company, on Lightning Creek, after a long and hard fight with slum and water, are at last feeling that success is about to crown their efforts. Every week is now bringing them a neat little pile of the yellow dust.

A party consisting of four men, with provisions for six weeks, started out recently on a prospecting trip from Barkerville to Goat river and vicinity.

Mr. Charles Ramos, superintendent Slough Creek Mining Co., returned to Slough Creek, together with Mr. W. J. Magee, one of the directors of the Slough Creek Mining Company. Mr. Magee, in company with C. H. Cobb, Albert Morris and John Hopp, has taken a contract to sink the main shaft. All the necessary machinery consisting of two 30 h.p. boilers, a large steam pump and one 12 h. p. hoisting engine, has been ordered from Toronto, and is due at Ashcroft by the last of September. Later on, a second pump will be secured.

Vancouver Island.

The New Vancouver Coal Mining and Land Company's coal shipments for August, amounted to 32,467 tons.

Miscellaneous.

The Slocan *Prospector* has strong faith in the effect of large and loud utterance, and in addition to damning most vigorously the rival town and people of Nakusp, prints in its last issue the following little editorial note in advertisement of the local mining resources: "It is not often that an editor may use a chunk of oré carrying 5,000 ounces of silver to the ton as a paper weight, from an inexhaustible mine less than three miles from the office. This is our paper weight, and indisputable evidence in favor of the future of New Denver."

The cost of shipping the last consignment of ore from the Bon Ton to Tacoma, with smelter charges, duty, etc., amounted in all to $99.50 per ton; comprised as follows: Freight charges from the mine to Kaslo, per ton, $30; sampling, per ton, $1.20; freight from Kaslo to Tacoma, per ton, $10; duty, 43 per cent., lead, per ton, $13; smelter charges, Tacoma, per ton, $21; discount on lead, per ton, $8; discount on silver, per ton, $15; total, $99.50. The probable returns will be about $290 per ton, leaving a profit of $190.50.

(Vancouver Enterprise.)

Capt. M. McLeod returned a day or two ago from Cayuse Creek, where the Enterprise Hydraulic Mining Company, of which he was one of the promoters, are working their claim. He brought down three splendid nuggets, aggregating 8 ounces, picked from the sluices. In addition to this he has two specimens of coarse gold, also taken from the sluices, though the cleanup has not taken place. The result is very encouraging, as they are now only cutting their way into where they consider the best paying earth lies. The Company has a splendid head of water, which was turned on about a week before Capt. McLeod left. The dump for the tailings could not be improved upon, and with such admirable results shown for the first week, the shareholders are beginning to feel hopeful of good returns on the money invested. The Company began operations three years ago, and after driving two tunnels, both of considerable length, they only now are able to get the first returns. The cleanup will not take place till the close of the season by frost, probably about the end of November, while it is confidently expected that March 1st of 1894 will see the mines again working.

(Nelson Tribune.)

The Kaslo sampling works were to begin this week on a lot of ore from the Idaho mine. After this ore is sampled, the Mountain Chief product will be run through. George Hughes is improving the road between the town and the sampler at his own expense.

D. J. Hughes, of the O K, was in town on Friday ordering supplies for the mine. While here Mr. Hughes sent $1,300 worth of gold to Spokane, which he and his two partners had taken from their mine in one week. The new strike in the O K is about forty feet higher up the mountain side than the main tunnel, and the ledge of free gold quartz has been uncovered to a width of thirty feet. In most of this quartz gold can be seen with the naked eye, and some of it is so rich that it pays the owners very big to extract the gold from the rock with a hand mortar. The owners not having any machinery on the ground, only the richest of the ore is worked; but we are informed that a stamp mill will soon be erected, and then all the ore can be worked at a large profit. A small creek, not more than a foot wide, runs within two feet of the ledge, and in the clay and pieces of broken quartz, which are washed from the seams and gathered in buckets, gold nuggets of considerable size are found. In one bucket of this clay and broken rock, we had the pleasure of seeing the owners extract $120 in gold. Messrs. Hughes, Cole and Oudin, the lucky owners of the O K mine, are very jubilant over their new strike, and we are sure they are deserving of all they find, as they have worked steady and hard to make their mine one of the best in Trail Creek district.

(Continued on page 165)

The Limitations of the Gold Stamp Mill.

By T. A. Rickard, Denver, Colorado.

(Chicago Meeting, being part of the International Engineering Congress, August, 1893.)

Milling is one of the metallurgical arts whereby the extraction of the largest possible proportion of the value in an ore is effected at the least possible expense. Stamp milling* is that particular process in which a heavy body of iron is caused to fall upon the ore so as to disintegrate it and thereby induce a separation between what is valuable and what is worthless. The latter is usually less in specific gravity, and is therefore, by the further aid of water, removed from the former, which is then collected by the use of mercury.

Several similes have been employed to describe this process. The stamp has been likened to a hammer of which the stem is the handle and the die the anvil. The ore upon which the stamp falls has been compared to a nut awaiting the descent of the hammer whose blow is to separate the valueless shell, the quartz, from the valuable kernel, the gold.

When we begin to pursue our inquiries, however, we find that the analogy is just sufficiently true to emphasize the departures from it. The hammer falls, the anvil is fixed; so with the stamps and the mortar. The anvil is made of softer metal than the hammer; so also the die is often, and should be always, of steel or iron less hard and more tough than that of the shoe. The movement of the hammer and the drop of the stamp are both intermittent.

In regard to their intermittent action, as in many other respects, stamp mills arrange themselves under two types, which, though apparently contradictory, have both been evolved from a common original, and are united by a great variety of intermediate modifications. The slow speed and the high drop of the mills of Gilpin county, Colorado, appear to have very little in common with the fast speed and short drop of those of the main gold belt of California; yet the practice of the one was largely derived from that of the other, and each has been adapted to the treatment of the ores of its particuler region.

The first and most apparent difference is that of speed. In Colorado the drop is regulated at 30 per minute, while in California it averages from 90 to 105. The more rapid drop gives a less intermittent action, and in this respect more nearly approaches the ideal machine.

The work done by the hammer is, however, dependent not only on the rapidity of its blows but also upon its weight and the distance through which it falls. Keeping to the two types, which we have chosen as representatives of the two systems of milling, we find that in Colorado the stamp weighs 550 to 600 pounds and falls a height of 18 to 20 inches, while in California the stamp weighs from 750 to 850 pounds and drops only 4 to 6 inches. Upon multiplication of these three factors—weight, drop, and speed—we find that the theoretical work done is nearly equal and is about one horse-power.

In milling, however, the efficiency of the stamp as a crushing machine is gauged by the quantity of ore which it can reduce, and we find that this does not at all correspond to the theoretical equality of the mills. In Colorado the stamp crushes 1 ton per twenty-four hours, while in California, with an ore of similar hardness, the amount is from two and a half to three times as much. Why is this difference? To explain it we must suppose the hammer to fall not upon the dry and wide surface of an anvil, but upon a face of iron confined within a narrow box and under water. This box corresponds to the mortar or coffer of the stamps. It has no opening* save in front, where a metallic grating or screen permits the escape of only that part of the material which has been crushed sufficiently small to pass through the openings. The ore upon the die is under water, the depth of that water depends upon the level of the bottom of the aperture occupied by the screen-frame. In Colorado the depth of discharge, as measured by the distance from the bottom of the screen to the top of the die, is 14 inches, but in California it is 4 inches only.† Herein lies the key to the difference in the crushing capacity of the two mills. Though the same amount of power be expended, and though the screen used be of similar mesh, yet in the Colorado mill the stamp falls through 10 inches more of water and has to discharge the pulp at a level 10 inches higher than in the Callfornia mill. The greater depth of discharge deadens the effectiveness of the blow of the stamp and weakens the force of the splash. Another result is obtained. While the screen does not in either case succeed in sizing the material discharged through it, yet it will be found that, though provided with similar screens, the pulp issuing from the deep mortar has a fineness much greater than that discharged by the shallow one. The pulverized ore is retained by the deep mortar long after its particles have been crushed to a size permitting their passage through the screen-openings, and they therefore become repulverized to a further degree of fineness.

This touches upon one of the points in respect of which the stamp-mill is most faulty. By actual test it is found that, though using a 40-mesh screen, for instance, with the theoretical supposition of crushing to that particular size, yet in a Colorado mill fully 70 per cent. of the pulp, and in a California battery about 50 per cent., will pass through a 100-mesh sieve. The percentage varies with the character of the ore, but these figures may be considered fairly representative. Two causes are chiefly responsible for this. The most important in its effects is the pause which occurs between the successive drops of the stamp. In a Colorado mill the interval is two seconds; in Califcrnia it varies from three-fifths to two thirds of a second. Particles of ore, which have been pulverized to a fineness which would permit of their exit through the screen, are enabled to settle towards the bottom of the mortar. It would be expected that the heavy metallic minerals occurring in the ore would, because of their greater specific gravity, be most affected by this feature of the treatment. In practice this is found to be so. The fine slimes contain a large proportion of metallic sulphides, generally valuable on account of their close association with the precious metals, while the coarsest particles to be found in the tailings usually consist of quartz and other minerals forming the less heavy gangue.

The want of any proper control over the regular sizing of the pulp is also due to the unequal and irregular splash of the water in the battery and the hap-hazard way in which the particles of pulverized ore strike against the screen. In the case of any single particle, for instance, it is a question of hit-or-miss whether it may be thrown against an opening or a blank. If it fail to pass through, it is thrown back by the recession of the water and undergoes a further agitation and probable pulverization.

In practice this feature of the stamp-mill is recognized by both the California and the Colorado millman. On the Pacific coast the mortars are made narrow, thereby diminishing the opportunities for the settling of the particles of ore, and, by increasing the force of the splash, adding to the chances of its exit through the screen. In late years there has also been a tendency to use wire-cloth in place of punched iron, for the reason that the former,

*I shall confine the discussion to simple goldstamp milling.

* The feed-hole is higher up and does not concern us here.

† In making the comparison between the two systems of milling, I have purposely chosen extreme types.

though having openings of indentical size, yet has more of them per square inch than the latter, and, therefore, presents a greater area of discharge. By giving an inclination of 10 degrees to the screen-frame, the exit of the pulp is further assisted.

In Colorado, this defect of the stamp-mill has been utilized, and has been made an assistant to the millman. The mortars of this district are wide and roomy, the splash of the water inside the battery is weak, and the pulp remains inside until pulverized to a fineness much exceeding that required for its passage through the screen. There is a reason for this apparently contradictory feature of the milling practice. To explain it we must glance at the ore. We find it to contain an average of 15 per cent. of pyrite. The gold is very fine and intimately associated with the pyrite. To separate them it is necessary not only to crush to a certain degree of fineness, but also to obtain conditions which will permit the gold when once separated to settle upon amalgamated plates placed inside. The deep discharge causes the pyrite to remain in the mortar-box long after it has been pulverized to a size smaller than the screen-openings; the long drop gives the interval of time required to allow of the settling of the fine gold, while the roomy character of the mortar aids the deep discharge in affording a chance for the gold to get out of the way of the falling stamps and to become amalgamated upon the two copper plates inserted at the back and front of the mortar. In this way about two-thirds of the total yield of amalgam is obtained inside the mortar. In California the introduction of plates is not admissible, in mortars having so shallow a discharge as 4 inches, because the more constant and more violent agitation of the pulp prevents the settlement of the gold and would cause the abrasion or "scouring" of the surface of amalgamated plates. A certain varying percentage of gold is, indeed, usually arrested inside, partly by the aid of mercury added to the ore as it is fed into the battery, but this is of such a coarseness that gravity alone would serve to keep it within the mortar.

We have now entered into the discussion of the effects produced by the action of the stamp upon the ore. In many respects it departs from the analogy of the hammer which cracks open a nut. While being lifted the stamp also turns. This is effected by the friction of the cam-surface against the under side of the tappet. In a slow-drop mill the stamp makes a complete turn each time it is lifted, but with an increased speed this action is more uncertain and from 4 to 10 drops are required to make a whole revolution.

This feature of the stamp-mill breaks the analogy to the hammer and anvil, and causes it to resemble the pestle and mortar. The turning of the stamp in rising is communicated to the ore when it falls and induces a grinding-action, which has important results. The mere impact of the stamp upon the particles of gold has the effect of hammering it, of increasing its density and of preventing its amalgamation, while the turning of the shoe upon the die causes the abrasion of the surface of the gold and the rubbing off of any film of foreign matter, which, by preventing contact between the gold and the mercury is prejudicial to amalgamation. In grinding the ore the stamp, however, also tends to convert it into slime. The hammer which cracks open the nut liberates the kernel without smashing it, but in pursuing the simile we find that the stamp not only breaks the shell, but both the kernel and the shell are further crushed, and their particles become confused together. The stamp which frees the gold from the quartz has to deal with a material in which the valuable and the valueless constituents are so uneven in size and so intermixed that the one is often crushed too much and the other too little.

I have seen auriferous quartz* which very nearly approached our simile of the nut. The gold occurred in seams and cavities in a quartz which had a honeycombed character. With such an ore there is just a certain blow which will break the brittle quartz and liberate the ductile gold. Such ideal conditions are very rare. The different parts of the same ore usually vary both in hardness and composition. The same work done on two pieces of mill-stuff will produce entirely dissimilar results. In the stamp-battery the heavy sulphide minerals are pulverized to a greater fineness than the siliceous gangue. When the gold is not too closely associated with the pyrite, coarse and rapid crushing will produce an adequate separation; but when the metal is in a finely divided condition and very intimately mixed with the pyrite, then fine crushing is demanded and can, unfortunately, only be obtained by the production of a very undesirable excess of slimes.

We have glanced at the results produced by the turn of the stamp upon the ore. Upon the mechanism itself the results are beneficial. The revolution of the stamp equalizes the wear upon the shoes and dies. It tends, also, by maintaining an even crushing-surface, to prevent that decrease of efficiency which occurs when either hammer or anvil has an irregular face.

Water is the vehicle used for the removal of the valueless portions of the ore from those which are valuable. Its low specific gravity as compared to both the metal and its enclosing gangue enables us to use it as a medium for their separation. A liquid having a specific gravity greater than that of water, and intermediate between that of the gold and its gangue, would be more effective if its use were practicable, which it is not.

In the mill, however, specific gravity is not the only factor we have to consider. The water discharged from a stamp-mill often transports the heavy pyrite further than the light quartz. This is due to the fact, already referred to, that the pyrite remains inside the mortar longer than the quartz and becomes pulverized to a further degree of fineness. It therefore, presents a larger surface to the water. Again, the metallic sulphides commonly occurring in gold ores have a cleavage more highly developed than that of quartz; therefore, while the latter finds its way into the water in irregular and angular grains, the former will be found in thin plates and flakes, which readily float upon a running stream.

Water is the fluid used, but air also plays its part. During the time of its violent agitation under the falling stamp, the water entangles a certain amount of air. Such air exists in the form of small bubbles which hold the finely-pulverized ore in suspension and thus become the main agent in the floating of the slimes. Warmth causes the air to expand and the bubbles to become dissipated; therefore any rise in the temperature of the water, such, even, as is caused by the impact between the stamps and the ore upon the die, is favorable to a diminution in the amount of slime.

When the pulp is discharged from the mortar-box it runs down copper plates covering long sloping tables. The copper, whether plain or silver-plated, is provided with an amalgamated surface, and it is this amalgamated surface which is supposed to do the work of arresting the gold. Mercury unites with gold forming a heavy amalgam; but, in practice, it is found that a plate which is covered with a good coating of gold-amalgam will serve to arrest gold much more effectually than a clean surface of either amalgamated silver or copper.

The amalgamating-tables have a slope varying with the amount of water used, the heaviness of the pulp, and the rapidity of the crushing. A gradient of $\frac{5}{8}$-inch per foot is common in Australia, while in Colorado the inclination is over 2 inches per foot.* The colonial mills consume 5 gallons of water per stamp per minute, while those of Colorado use less than 2 gallons. Theoretically, the use of the least possible quantity of water, and the spreading of the pulp over the largest possible surface, will give the best separation of the gold from the gangue. In practice, the varying composition of the ore prevents a nice adjustment of the conditions. You may readily determine an inclination which will be most effective in causing a separation of the gold from the quartz, but, it may be such as to cause the pyrite to settle. On the other hand, the slope may be so adjusted that the pyrite is carried away; but, such conditions may then be obtained as will also permit of the escape of the gold.

The amalgamating-tables are attached to the framework of the mill. The vibration set up by the falling stamps causes a pulsation of the water flowing over the plates similar, in a way, to the action of a jig. This assists the work of gravitation. The vibration has, however, another effect, namely, that of crystallizing the iron of the working parts of the mill, making them brittle and decreasing their time of service. In this, as in other respects, the stamp-mill presents contradictory features.

At the outset, we described milling as the art of treating an ore so as to extract the maximum of value at the minimum of expense. Let us apply the description to the two types of mill to which particular reference has been made. In Colorado, a stamp crushes 1 ton of the ore of the Gilpin county mines in 24 hours, and the cost, using free water power, is 70 cents. In California, the best equipped large mills crush at the rate of rather more than $2\frac{1}{2}$ tons at a cost, also using free water power, of about 35 cents per ton. The extraction in both regions will be, by amalgamation alone, about 70 per cent. We will omit the amount extracted by the concentration of any valuable pyrite, because the percentage of such material is very variable, and it forms a by-product, the value of which depends largely upon local conditions.

The ore of the Gilpin county mines carries about 15 per cent. of pyrite, and other heavy sulphides. The gangue is more feldspathic than quartzose, and is the product of the alteration of the country-rock—granitoid gneiss—and of the dikes† which penetrate it. The gold is not only present in a state of very fine subdivision, but it is also intimately associated with the pyrite.

On the other hand, the mill-stuff treated in Amador, Calaveras and Tuolumne carries from 1 to 2 per cent. of pyrite. The gangue is quartz, but the ore also contains a very large proportion of the country-rock, which in this case is slate, augite schist, and diabase. Of these, slate predominates. The gold is coarser than that of the Colorado ore, and it is not so closely associated with the pyrite.

Let us now consider the results to be obtained by an interchange of treatment, using California batteries on Colorado ore, and *vice versa*.‡ The Gilpin county ore is of medium grade, say 8 dwts., or $8 per ton. The local methods extract $5.60§ at a cost of 70 cents. A California mill would give an extraction of only $4, but would crush such soft ore fully three times as fast, so that the cost would be, say 25 cents, giving a net yield of $3.75 as against $4.90 obtained by the methods of the district. Here, the slower mill gives the best results with a particular ore, and the Colorado millman conisders the Californian very stupid because he does not use Colorado methods. Let us go to California and use the Gilpin county mill upon an ore of simpler character and of lower tenor. We will consider the treatment of an ore containing 6 dwts., or worth $6 per ton. The California mill would extract 70 per cent. at a cost of 35 cents, leaving a balance of $3.95 per ton. The Colorado battery would extract an increased percentage, say 75 per cent., but the ore being much harder than that of the Gilpin county, the crushing capacity would be less and the cost per ton greater than when treating county ore, say, therefore, $1.00 per ton, leaving a net yield of $3 50 per ton. The California mill, if crushing 100 tons of ore per day, would, therefore, show a profit $45 per day greater than that of the Colorado mill. As a matter of fact, there are other practical considerations which would render inadvisable the interchange of methods, among which may be mentioned the smaller size of the ore-bodies of Gilpin as compared to those of California; while it must also be remembered that the construction of a Colorado mill of a capacity equal to that of a California plant would require twice as much capital.

The comparison just made will serve as an illustration of the fact that milling is a business for getting money, and not a scientific pursuit directed to the obtaining of a perfect metallurgical treatment.

The contrast between the methods in use in two mining districts in the same country, illustrates the first axiom of all successful ore-reduction, namely, that the treatment must be suited to the character of the ore. Colorado methods in California would probably fail just as surely as California ways has been unsuccessful in Gilpin county. This is a truism not always remembered by machinery firms, who do not desire to be bothered by the making of new patterns. Too often, the ore is required to bend to a certain treatment in a mill of a particular design, instead of the mill being modified to suit the necessities of a particular ore.

The stamp-mill has presented to us many contradictory features. It is seen to be compounded of good and ill. It may be simple, but it is clumsy; it may be crude, but it is effective. As a machine, it has undergone an evolution common to all human inventions. It was founded on the first stone implement of the prehistoric savage; it became modified into the *matate* of the Mexican and the tilt-hammer* of the Chinese; it progressed until running water was called in to aid human muscle, and in the machine of the Hungarian peasant, it reached the primitive type from which our present mills were envolved. How great has been the comparatively recent improvement can be seen by stepping from Hungary to California.

In the valleys around Verospotak, in Transylvania, the larger mills† consist of twelve stamps, in coffers holding four each. The power is derived from an overshot water-wheel 10 feet in diameter. The cam-shaft is of iron, and revolves on agate bearings, lubricated with water. The lifter, or cam, is iron-shod. The stamp weighs 250 pounds, and has an agate head. The stem, the coffer, and all the rest, are made of beechwood. Each stamp drops 30 times per minute, and crushes about 300 pounds of soft ore per 24 hours. These machines have changed but little since the time of the Roman occupation under Trajan, when this district was a part of the province of Dacia.‡

Let us now go to California, whose record is little more than the record of a generation. Among the foothills of the Sierra Navada we find mills containing 80 stamps, weighing 750 to 850 pounds each, dropping 95 times per minute. Those of the working parts which are not of iron are made of steel. At single mills, 200 tons of ore are crushed per day. The mill building has a height of 70 feet, and the ore is never touched by manual labor from the moment that it arrives at the top in the mine-cars to the time when it is discharged at the bottom as waste.

In Transylvania, the individual shareholder often has his own mill; in California a thousand unite to operate one, which can, in 24 hours, treat as much ore as the Hungarian mill crushes in 100 days. The little machine of the Hungarian has been tapping away like a woodpecker for eighteen centuries, and yet has not produced as much gold as has been contributed in the brief time of one generation by that completer mechanism whose muffled thunder echoes among the canons of California.

What has been done may serve as a measure of what can yet be done. Perfection is as unattainble in milling as in any other branch of industrial art; otherwise progress were soon ended. We can compare the old mill with the new, not only with a complacent satisfaction at the advance that has been made, but with the consciousness that where so much improvement was possible much room for improvement must remain.

It is not for me to attempt to foretell what place the stamp-mill is destined to hold in the metallurgy of the future. Let me, however, in concluding, suggest the reflection that though the appliances of to-day may show a great advance upon the older more imperfect type from which they were evolved, yet there is no mining district that possesses a mill which cannot, in some essential, be improved upon.

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* At Clunes, Victoria, Australia.

* An Australian mill usually crushes 2 tons per stamp per 24 hours.

† The "porphyry" of the miners; really, quartz-andesite.

‡ In making the comparison the cost of motive power, being very variable, is left out of the count.

§ Amalgamation only, omitting concentration afterward, is here included.

* "A Chinese System of Gold-Milling," by Henry Louis, *Trans.*, xx., 324.

† Modern American mills have been lately introduced, and can be seen working side by side with those dating back to 100 A.D. For the particulars above given, I am indebted to Mr. E. H. Liveing.

* Well-preserved gold coins of the time of Trajan have been found in the mine-dumps.

Mining in Ontario.

Mr. A. Blue, Director of Mines, and his capable assistant, Mr. T. D. Gibson, have issued their annual report of the mining operations in Ontario for the year 1892, being the second volume published since the Bureau of Mines was established. The volume comprises nearly 300 pp., is excellently gotten up, carefully and handily indexed, and the mass of information it gives cannot fail to be of great benefit to the Province, not only in attracting attention to its mineral resources, but also as a medium for reference to those engaged in mining enterprises. The opening pages are devoted to statistics, from which we gather that in 1892 a revenue of $15,273 was derived from the sale of 65 mining patents, covering 6,200 acres in various localities, the district of Thunder Bay yielding $5,598 for 2,391 acres. No fair comparison can be made with the previous year, for the reason that in 1891 a large number of patents were issued under the provisions of the old Mining Act. From the next table we find that a rental of $12,314 was derived from 13,122½ acres leased in the districts of Thunder Bay, Rainy River, Algoma, Nipissing and elsewhere. The leasing clause went into operation on 4th May, 1891, when 47 leases were issued, embracing an area of 4,998 acres, and the first year's rental paid was $4,886. As evidence of the continued growing favor of the system with miners in the Province, we are told that the number of leases issued to 6th May of the present year has increased to 54, covering 2,912 acres, so that it is very probable there will be a substantial increase over last year. Regarding the mineral production of the province in 1892, we cannot do better than quote the concise review given by the report.

"About one hundred quarries were worked during the year for building stone material, chiefly limestone and sandstone. It was not possible to procure returns from all of them, but a careful estimate gives the following statistics of quantity and value for the different classes of material :—

Dimension Stone,	cu. ft.,	2,600,000.....	$680,000
Heads and Sills,	cu. ft.,	50,000.....	26,000
Coursing Stone,	sq. yd.,	64,000.....	42,000
Rubble, etc.,	cu. yd.,	730,000.....	132,000

making a total value of $880,000. The amount of wages paid to workmen was $730,000.

"Much the greater portion of the cement made in Ontario is the product of natural rock, but although the quantity was 7,977 barrels more than in the preceding year, the value was $839 less. Portland cement began to be made in 1891, when the output was 2,033 barrels, valued at $5,082. The quantity and value of both classes produced last year are given in the following table :—

Natural Rock,	bbl.,	54,155.....	$38,580
Portland,	"	20,247.....	47,417

making a total of 74,402 barrels, valued at $85,997. The amount paid for wages was $53,151.

"The returns received of the quantity of lime burnt last year are not complete, but an estimate places it at 2,600,000 bushels, valued at $350,000, with amount for wages of $120,000.

"The following table gives the quantity and value of drain tile, common and pressed brick, roofing tile and terra cotta made in the Province last year—drain tile and common brick being an estimate based on 161 returns :—

Drain Tile,	No.	10,000,000.....	$100,000
Common Brick,		175,000,000.....	980,000
Pressed Brick, plain,		20,342,000.....	198,350
"	fancy,	1,323,000.....	32,253
Roofing Tile,		383,000.....	8,613
Terra Cotta			20,119

"The pressed brick works have added largely to the output of 1891, the increase in the number of pieces being 8,431,000, and in value $102,636. One new establishment was put into operation during the year, that of the Thomas Nightingale Pressed Brick Co. at Port Credit. The brick at these works is made from the red shale of the Medina formation. The amount paid for wages during the year by the pressed brick companies was $88,865. The amount of wages paid for making common brick and drain tile was $445,000.

"The value of pottery made during the year was $80,000, and the amount of wages paid to workmen in the business was $25,000.

"The gypsum mining industry has been quiet during the year, and production was only 72 per cent. of the previous year's. There has been, however, a considerable increase in the manufacture of alabastine and plastico. Following are the figures for the year :—

Gypsum,	tons,	3,870.....	$14,100
Alabastine and plastico	"	108.....	11,800

The amount paid for wages was $10,465.

"The depression in the phosphate business still continues as a consequence of the low price at which Florida phosphate is sold in the European markets. Only three of the Ontario mines were worked last year, and these to much less than their full capacity. The total quantity raised was 2,381 tons, valued at $23,810. The amount paid for wages, including some development work on other mines, was $9,400.

"The total quantity of salt of all kinds made during the year ending October 31, as reported to the Bureau by Mr. John Ransford, Secretary of the Association, was 43,387 tons, valued at $162,700. It has not been possible to get information in detail, but the following figures are compiled from returns made by the owners of six salt works :—

Coarse Salt,	tons,	2,550.....	$ 9,005
Fine Salt,	"	8,221.....	35,461

"The cost of wages for this quantity of coarse and fine salts was $9,885. Computed at the same rate the cost of wages for the total make of the year would be about $37,800.

"The salt producing territory of the Province was proven last year to extend as far south as Windsor. A well drilled at the Canadian Pacific Railway station struck a bed of salt 30 feet in thickness at a depth of 1,138 feet. In the township of Orford, in Kent county, a deep well drilled in 1890 for natural gas by Mr. Hiram Walker, of Walkerville, went through a bed of clear white salt 171 feet in thickness, reaching it at a depth of 1,510 feet.

"The salt beds of the Province are proven by borings and producing wells to extend under the whole of the counties of Huron, Lambton, Kent and Essex, as well as portions of Middlesex and Bruce, and to cover an area of about 4,000 square miles. Near the borders of the formation the salt thins out to one bed, but in Huron there are usually to be found three distinct beds, separated by shale, whose aggregate thickness is about 90 feet. The greatest known thickness of a deposit is in the southern limit of the field where, as shown by the record of Mr. Walker's boring in Orford, there is one bed 171 feet in thickness.

"Only one of the mica mines was worked last year and it produced but seven tons, valued at $1,500. The amount of wages paid for labor was $150.

"Four companies carried on mining and smelting operations in the Sudbury district last year. The quantity of ore raised was 72,349 tons, and the quantity smelted was 61,924 tons. Three of the companies have erected bessemerizing plants in connection with their works, employed to enrich the matte ; but only a portion of the matte is treated by this process. The quantity of ordinary matte produced at all the furnaces was 6,278 tons, and of bessemerized matte 1,880 tons. The following table gives the estimated metal contents of these mattes and their values at the works :—

Nickel,	tons,	2,082.....	$590,902
Copper,	"	1,936.....	232,135
Cobalt,	"	8½.....	3,713

"The total value of the metal contents therefore was $826,750, the nickel being calculated at $284 per ton or 14.2 cents per pound, the copper at $120 per ton or 6 cents per pound, and the cobalt at $437 per ton or 21.84 cents per pound.* All the ores yielded nickel, the average being 3.36 per cent. ; the ores of three companies yielded copper, the average being 3.19 per cent. ; and the ores of one company yielded cobalt, but the average was only .1007 per cent.

"At the mines there was employed underground an average of 197 men, and above ground of 243 men over seventeen years of age, while of boys under seventeen years of age there was employed an average of only 10, all above ground. The average number of men employed at roasting and smelting was 240—the average of all classes of workers being 690. The mines of one of the companies were worked 310 days, of another 261, of a third 173, and of the fourth 155. The smelting works of one company were in blast 337 days, of a second 290, of a third 67, and of the fourth 32. The aggregate of time of labor in the mines may therefore be computed at 105,890 days, and at roasting and smelting 52,428 days, making a grand total working time of 158,318 days for the 690 employés. The amount of wages paid for labor by the four companies was $339,821, and the average wage per day would therefore be $2.14⅔.

"Gold mining has been comparatively active during the year, but the work carried on has been mostly of development character. Locations have been worked in the county of Hastings, in the district of East Algoma and in the region of Lake-of-the-Woods. Nine companies have made returns of work done during the year ending 31st October, which show that 3,710 tons of gold ore was mined, the value of which is estimated at $36,900. The number of men employed above ground by these companies was 85, and the number underground 40. The aggregate working time of the men was 12,932 days, and the amount of wages paid was $22,750. The average wage per day would therefore be $1.76.

"Mills for treating the ore were being erected at a number of mines, several of which are now in operation. New processes of treating ore are being adopted, and interesting results are looked for this year.

"In the month of December eight properties were in course of active development on Lake-of-the-Woods, the number of mines and laborers employed upon them being 159. Since then reduction mills put up at two of the mines have, it is reported, been treating the ores very successfully. According to accounts published in the Rat Portage newspapers, gold bricks of the value of $1,000 are produced by each plant weekly.

"The Ophir mine, north of Thessalon, was purchased last year by a Duluth syndicate for $100,000. Several shafts have been sunk on the vein and the show of gold has aroused lively expectations. Treating works are being erected at the Ophir, and it is expected that they will be started in the month of August.

"The Creighton Gold Mining Co. is developing a location of much promise in the township of Creighotn, west of Sudbury. Sixty-three men were employed on the works in February, at which time a shaft of 8 by 9 feet was sunk upon the vein to the depth of 110 feet. Steam drills and hoists were in operation at that time, but air compressors, crushers and other machinery had been ordered and suitable buildings were in course of erection.

"Three mines are being worked in the county of Hastings one of which has reached a depth of 140 feet. The pyritic ore at this latter mine is being treated in a Crawford mill, and the yield of gold is stated to be very satisfactory. At one of the other mines a new process of treating mispickel ore is going to be tried, which is claimed to give good results in the laboratory.

"Nearly all the silver mines in the Lake Superior district have been idle during the past year, and the work done on five or six locations had for its chief object the opening and proving of veins. This is one of the results of the depreciation of silver. An accompanying result is the activity noticed in gold mining, which is also a feature of the industry in the United States and elsewhere.

"At one of the mines six men were employed underground and one above ground for 306 days, and the amount of wages paid for labor was $3,942, or at the rate of $1.84 per day. Ten tons of ore was taken from this mine, the value of which is put down at $732.

"The quantity of crude petroleum produced in the Petrolea and Oil Springs fields was 800,000 barrels (28,000,000 imperial gallons), valued at $1,000,000. This is 94,647 barrels less than for the preceding year.

"Full details of the industry have not been obtained, as only five refineries have made returns to the Bureau. These refineries treated 11,929,446 gallons in the year, being 42.6 per cent. of the whole yield, the product of which is given in the following table :—

Illuminating Oil,	imp. gal.,	4,627,593....	$391,628
Lubricating Oil,	"	1,472,924....	58,918
All other Oils,	"	3,260,912....	116,118
Paraffin Wax,	lb.	276,027....	29,922

"The amount of wages paid for labor at these five refineries was $40,517. On the same basis, the refined product of the total crude yield of the year would be—

Illuminating Oil,	imp. gal.,	10,862,894...	$919,315
Lubricating Oil,	"	3,457,570...	138,304
All other Oils,	"	7,654,723...	272,577
Paraffin Wax,	lb.	647,950...	70,239

"This would give a total value of distilled products of $1,400,435, and at the same rate the amount of wages paid for labor would be $95,110. This does not of course include wages paid to workmen employed in the production and storage of crude petroleum. The total number of employees maintained by the industry is estimated to be about 1,500, and the amount of wages paid for labor of all kinds about $650,000.

"In the Welland gas field forty-nine wells were bored last year, of which thirty-six are gas producers. The total number of producing wells in the district is sixty-five In Essex two new producing wells were bored last year, and there are now eight in that district. There are about one hundred and fifty miles of pipe laid for the delivery and distribution of gas in both districts, and the value of gas sold to consumers last year was about $160,000. The total amount of wages paid for labor was $55,000, a large proportion of which was for drilling new wells. The returns received from gas companies have not been very satisfactory, especially those made by companies delivering to consumers in Buffalo.

"No iron mining is reported for the year, but several properties were prospected with a view of proving the quantity and value of their ores.

*The quantities here given are the estimated contents of the respective refined metals in the mattes, but values are computed on the selling price of mattes at the works and not on the price of the metals after they have been refined in Great Britain, the United States or elsewhere. London quotations for nickel ruled steadily at 42 cents. per pound, and New York quotations at 48 to 50 cents during the latter half of the year—the higher price in the United States being maintained by the protection of the customs duty. But it would be very misleading to make the value of nickel contents in the matte at Sudbury the same as the value of refined nickel in New Yorkor London.

Quantity and Value of Mineral Production (in Ontario) and Amount of Wages Paid for Labor in 1892.

Product.	Quantity.	Value. $	Wages. $
Dimension Stone.....cu. ft.	2,600,000	680,000	
Heads and Sills..... "	50,000	26,000	730,000
Coursing Stone.....sq. yd.	64,000	42,000	
Rubble, etc.....cu. yd.	730,000	132,000	
Natural Rock Cement..bbl.	54,155	38,550	
Portland Cement..... "	20,247	47,417	53,151
Lime .....bu.	2,600,000	350,000	120,000
Drain Tile .....No.	10,000,000	100,000	
Common Brick. ..... "	175,000,000	980,000	445,000
Pressed Brick, Plain.... "	20,342,000	198,350	
" Fancy .. "	1,323,000	32,253	
Roofing Tile..... "	383,000	8,613	88,865
Terra Cotta..... "	.....	20,119	
Pottery ..... "	.....	80,000	25,000
Gypsum .....tons.	3,870	14,100	
Alabastine and Plastico "	108	11,880	10,465
Phosphate of Lime .... "	2,381	23,810	9,400
Salt .... "	43,387	162,700	37,800
Mica ..... "	7	1,500	150
Nickel. ..... "	2,082	590,902	
Copper ..... "	1,936	232,135	339,821
Cobalt..... "	8½	3,713	
Gold Ore ..... "	3,710	36,900	22,750
Silver Ore ..... "	10	732	3,942
Petroleum ....imp. gal.	28,000,000	.....	
Illuminating Oil. "	10,862,894	919,315	
Lubricating Oil . "	3,457,570	138,304	650,000
All other Oils ... "	7,654,723	272,577	
Paraffin Wax .....lb.	647,950	70,239	
Natural Gas	.....	160,000	55,000
Totals	.....	5,374,139	2,591,344

"The total value exceeds the production of last year by $668,466; but the principal increase is in nickel and copper, in which there is a different basis of values for the two years. The table, it may be explained, gives no account of properties upon which exploratory or development work was done during the year. Of these there are a considerable number, especially in the gold and nickel fields. In some cases numerous test pits and shafts have been sunk and several hundred tons of ore raised; a work which, though not included in statistical returns of quantity, value or wages, may come to have an important effect on the future of mining operations in the Province."

The other features of this very excellent report are: a review of the history of iron making in Ontario, followed by an interesting description of the known iron resources of the Province; a chapter of facts and opinions on the iron industry garnered from various well known authorities, the subject terminating with a reproduction from the *Engineering Magazine* of Mr. John Birkinbine's paper on the subject of "Locations for Pig Iron Production." In concluding his presentation of the subject Mr. Blue says:—

"The long story of invention is not closed, and in so far as the art of iron making is concerned it is not likely to close while impurities in ores and fuels continue to baffle the ingenuity of man. But the iron masters are in the line of improvement, and aided by science they are making sure headway in the face of many difficulties. The iron ores of Ontario are no worse than ores elsewhere; indeed it is almost certain that they are freer from at least one objectionable element, phosphorus, than those of other countries in which supplies are mostly found in the more recent rock formations. Better ways of treating ores in preparation for the blast furnace, and better ways of improving and refining iron and converting it into steel, as well as of strengthening it in combination with other metals, are being found out by skilled men in the laboratory, the furnace and the workshop; and every advance so made is a gain in which the whole world may share. There is not a process in the preparation and smelting of ores, not an improvement in the blast furnace, not a method of refining or working the metal, not an economy in any operation from opening the mine to the last touch of finish in the workshop, but is as free and open to us in Ontario as it is to the people of any country or state in Europe or America. Why then should not effort be directed to utilize one of the most valuable of all the raw resources of our country, converting it into wealth by the wisely controlled agencies of capital and labor, and making it an instrument for the production of greater wealth by ways and means almost without limit and number? A talent kept buried in the earth will be no more than a talent a hundred years hence, while if rightly utilized it may reproduce itself a thousand fold in a hundred years."

The nickel industry also finds prominence in an able paper, which we reproduce in this number. The memoir of Mons. David Levat, in the *Annales des Mines*, on the "Metallurgy of Nickel," from which we quoted last month, is given in full and is sure to prove of interest, and there are also papers by Dr. Stephen Emmens and others. In Section XI. is given "A Pioneer's experiences on Lake Superior and Lake Huron," by Mr. Walter W. Palmer, an interesting paper of value as throwing light upon an epoch in Canadian copper mining now well-nigh forgotten (year 1848). Dr. C. W. Volney contributes a paper on "Lithographic Stone," and Prof. Coleman, of the School of Science, Toronto, describes the admirable mineral exhibit made by the Province this year at the Worlds Fair. The paper on the "Utilazation of Peat," read before the General Mining Association of Quebec, by Mr. T. W. Gibson, and that on the "Mining Laws of Ontario," read by the Director at the recent Montreal Mining Convention, are also reproduced. The report is concluded by Mr. A. Slaght, the Inspector of Mines, who describes the nature and progress of mining by the various operators during the year. We heartily commend the report, not only to those who may be interested in the great mineral resources of this Province, but to all our readers, feeling sure that they will be the gainers by its perusal.

Nickel and Copper in Ontario.*

The Sudbury district continues to be searched for copper and nickel, and discoveries of the ores of these metals continue to be made in various localities. The area is now shown to be of large extent; but the limits of it are not defined; neither is it certain that every body of ore even in territory most familiar to prospectors has yet been discovered. The close growth of small timber on tracts swept over by forest fires twenty or twenty-five years ago hide out-croppings of ore, or the familiar surface signs by which its presence is indicated, from any but the most careful examination, while the alternation of rocky range and swamp land greatly increase the difficulty of traversing the country. It is not unlikely therefore that the diligent prospector will be rewarded by new and perhaps important discoveries of ore for some time to come at points convenient to existing railway lines, and that it will be many years before the whole of the nickel and copper-bearing formations are delimited on the maps of the country. But what is already known of the extent of the ore bodies, both by deep workings in the mines and the test pits of exploring parties, leaves no doubt in the minds of practical men who have examined the district that nickel and copper are there in illimitable amount; and the strong probability is that a hundred years hence the supply will appear to be as inexhaustible as it is to the miners and explorers of to-day. It is likely too that other parts of the Province besides the Sudbury district will be found to yield both nickel and copper. The Huronian belt, in which the known deposits lie, extends from the north shore of Lake Huron across the Province to the Quebec boundary at Abbitibbi Lake, a distance of 300 miles, the breadth of which is about 75 miles,—but embracing some Laurentian areas. On the shore of Lake Huron copper and nickel were discovered in this belt nearly fifty years ago, and far to the northeastward of Sudbury prospectors report that they have observed indications of the same ores. Of course the character of the Huronian rocks is not uniform over a wide extent, and great local differences may be looked for in an area of 22,000 square miles; but it is certain that all the chalcopyrite and nickeliferous pyrrhotite of this great Huronian belt are not confined to one or two townships in the vicinity of Sudbury. During the past year too, a discovery is reported on Lake-of-the-Woods, which may be only the beginning of valuable finds there. At any rate, further prospecting in that region ought to be encouraged by the history of exploration in the Sudbury district. Interest has also been recently revived in the Bruce mines locality, and possibly the old workings there which were carried on with so much spirit for thirty years—beginning with 1846 and ending with 1876—may once again become the scene of an active industry. It is by no means certain that those mines could not be made to pay under modern methods of working and with the facilities for transportation which are now provided.

COPPER ON POINT MAMAINSE.

A locality of bright promise is Point Mamainse on the east coast of Lake Superior, where development work has been undertaken during the past year, and to which reference is made in the Report of the Inspector of Mines, who visited the place last summer. The following interesting account of this property and the nature of the work undertaken upon it was furnished me last November by H. S. Sibley, of Detroit, in the course of an interview:

"I am one of two trustees holding for a syndicate the Mamainse copper locations on the east coast of Lake Superior. They consist of 11,200 acres, which were purchased from the Crown by the Montreal Mining Company in 1856. A little prospecting was done by Joshua Coatsworth about 1858, and afterwards by the Ontario Mineral Lands Company in the winter of 1881-2. Two small exploring shafts were sunk in the conglomerate on the Pancake location. This bed is 9 to 14 feet thick and carries one to two per cent. of native copper. No further work was attempted until the autumn of 1891, when a party with Captain T. H. Trethewey in charge, was sent up to explore with a diamond drill outfit. Drilling was carried on upon five veins to the extent of 3,643 feet, and to 357 feet on a conglomerate bed; the cores showed native copper to depths of 40 to 320 feet in the veins. The veins vary in width from 3 to 12 feet, and consist of calcspar and fragments of wall rock (conglomerate and trap) cemented by native copper. Jasper pebbles are also found in the veins. In 1892 drilling was continued until July, but in June work was commenced on an exploring shaft 7 by 9 feet, which was carried down upon one of the veins to a depth of 32 feet. A stream runs along the course of this vein, crossing and re-crossing it at intervals, so that some difficulty was experienced in keeping the shaft free from water with the methods at control. The ore was found to be rich throughout the whole depth of the shaft, and so satisfactory was it that the men were set at work to strip the vein and make open cuts upon it at various points for a distance of 1,600 feet; the width varies from 3 to 6 feet. The course of this vein is a little west of north, and lies between amygdoloid trap on the west side for foot wall, and conglomerate on the east side for hanging wall, showing a lateral thrust of 90 feet. About five tons of ore was taken out of the shaft, from which fair samples were selected and sent to the St. Louis sampling and testing works in August. Following is the report made to me by the manager of these works:—

"'ST. LOUIS, MO., Sept. 20, 1882.

"'*H. S. Sibley, Esq.*,

"'*80 Griswid Street, Detroit.*

"'DEAR SIR,—We have just wired you results of tests of the two lots of copper ore sent us, and we herewith present more fully the details of these tests. The larger sample lot, weighing 1,196 lbs. net, was crushed in the jaw crusher and run through our three-stamp battery to separate the rock material and finer copper from the coarse metallic copper. The former as tailings were carefully saved in settling tanks, weighed and sampled and assayed for copper and silver. The coarser metallic copper was carefully sampled down three times to secure three separate samples in order to secure a better check on a difficult material to sample. These three samples were assayed for copper and silver separately, and the average taken. As a result of all these operations we find the lot to contain 22.78 per cent. metallic copper and a trace of silver. The other sample lot marked gray ore was crushed in a jaw crusher and rolls until it was fine enough to quarter down to sample. An assay for copper and silver gave the following results: Copper, 18.84 per cent.; silver, 1.08 oz. per ton. We regret that owing to the great difficulty in handling such obstinate material we have not been able to give results sooner, but trust they will be in time to serve your purpose. Yours truly,

"'ST. LOUIS SAMPLING AND TESTING WORKS,

"'WILLIAM B. POTTER, Manager.'

"The gray copper ore is found generally throughout the vein, but chiefly on the foot wall. The native copper ore is generally disseminated from wall to wall. The trustees have given an option on the property to a Detroit syndicate, by whom operations to sink the shaft to a depth of 500 feet will be carried on through the winter. This work it is hoped will be finished in ten months. Air compressor, hoisting engine, boilers, drills and all necessary supplies were delivered at Point Mamainse on the 17th of November."

The geological formation at Point Mamainse is the same as that of Keweenaw point on the south shore, where are located the great copper mines of Michigan.

THE PRODUCTION OF NICKEL.

The quantities of ore mined and smelted in the Sudbury district last year are given on page 8 of this report. The product of the furnaces, consisting of ordinary and bessemerized matte, held of metallic nickel 2,082 tons, of copper 1,936 tons, and of cobalt 8½ tons. These figures of metallic contents are estimates computed from the analyses of sample lots, and are no doubt as accurate as such estimates can be made; they are so accepted by sellers and buyers of the matte. The whole matte product of the several furnaces is sent out of the country to be refined, some of it to Great Britain, some to France, but the greater portion of it to the United States. There is in the latter country an extra demand owing to the use of nickel as an alloy with steel in the manufacture of armor plate for battle ships. In 1891 the quantity of nickel contained in Canadian matte smelted in the United States was 2,000,000 pounds, some of which went into the general market, but a considerable amount of it was the matte purchased by the Navy Department. This latter is worked up by contract, the copper being taken out and the nickel and iron being left as oxide, in which form it is delivered to the steel works at Bethlehem and Homestead to furnish the nickel for armor plates.† There are at present four smelting or refining works in the United States for treating nickel and copper mattes, viz: The works of Joseph Wharton at Camden, New Jersey; those of the Orford Copper Co., at Constable Hook, in the Same state; those of the Emmens Metal Co., at Youngwood, in Pennsylvania; and those of the Canadian Copper Co., near Cleveland. Until recently, Joseph Wharton had a monopoly of nickel production in the United States, and his mine at Lancaster Gap, in Pennsylvania produced the bulk of the ore treated at his refining works. But since the beginning of 1889, Sudbury has been brought into competition with it, and the result has been the closing at the end of 1891, of the Lancaster Gap mine. So that in 1892 the product of the nickel smelters will be all from Canada, except occasional small amounts from Mine LaMotte, and from Nevada, Oregon and the mines near Webster, North Carolina.‡ The following table gives the total nickel product of the United States for the sixteen years 1876-91, together with the value of the same and the value per pound:—

YEAR.	Quantity. Lbs.	Value. $	Value per lb Cents.
1876	201,367	523,554	260
1877	188,211	301,138	160
1878	150,890	165,979	110
1879	145,120	162.534	112
1880	233,893	257,282	110
1881	265,668	292,235	110
1882	281,616	309,777	110
1883	58,800	52,920	90
1884	64,550	48,412	75
1885	277,904	179,975	64.4
1886	214,992	127,157	59.14
1887	205,566	133,200	64.75
1888	204,328	127,632	62.46
1889	252,663	151,598	60
1890	223,488	134,092	60
1891	118,498	76,024	64
Totals.	3,087,554	3,043,509	98.57

The nickel contents of the matte produced at Sudbury furnaces last year, therefore, are greater than all the nickel produced by United States mines in sixteen years by 1,076,446 pounds. It will be observed also that the price of nickel as computed from values of the United States product has fallen very materially since 1876. This drop is due chiefly to the working of the New Caledonia mines, by which the world's production was largely increased. Canadian nickel has had a less noticeable effect, but no doubt for the reason that price is determined now mainly by the cost of refining. Yet the ruling price in the London market last year was about 42 cents per pound, while in the New York market in the latter part of the year, quotations when given ranged from 48 to 52 cents—the protection afforded by the United States tariff of 15 cents per pound serving to keep up the higher rate in that country. But these prices are presumably for commercial nickel, which is not pure fine.

METHODS OF EXTRACTING THE METAL.

There are numerous methods already patented for

* From the Report of the Bureau of Mines, Ont., 1893.

† Mineral Resources of the United States, 1891, p. 167.

‡ Ib. p. 167.

treating ores containing nickel, copper and cobalt, but almost all of them follow the wet process. In a subsequent section of this report details of treatment are given in a paper by Mons. Levat, and here it may be interesting to give a general description of the process from the pen of Prof. Roberts-Austen, of the Royal College of Science, England:—

"The wet method for the extraction of nickel and cobalt from a complex regulus or arsenide consist, in the first place, of a roasting operation having for its objcct the volatilization of the sulphur and arsenic, and it may be antimony, and the conversion of the iron, nickel, cobalt and other metals present into oxides. Ferric oxide formed in this manner at a high temperature is but little soluble in acids, whilst the other oxides may be readily dissolved. On treating the roasted material repeatedly with hydrochloric acid or with dilute sulphuric acid, a residue is obtained containing but little or no cobalt or nickel, and consisting mainly of ferric oxide. Some iron will, however, have passed into solution. Should the solution contain lead, bismuth or copper, these metals may be precipitated by sulphuretted hydrogen; but it is customary to precipitate the copper at a later stage of the operations. The bismuth too, may be precipitated from a hydrochloric acid solution by dilution with water.

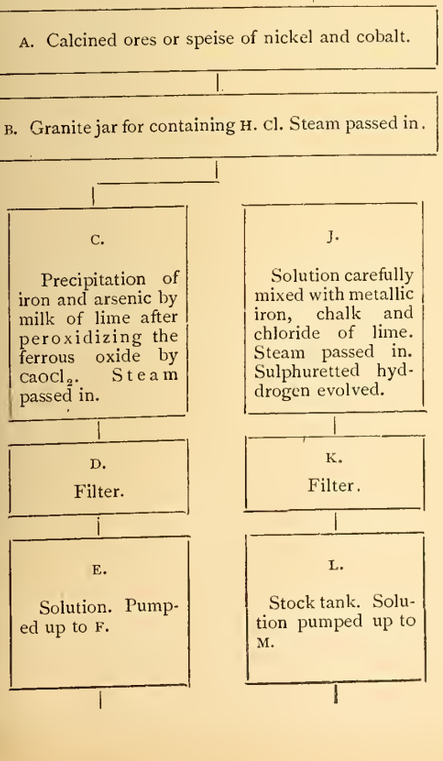
"The next operation consists in the precipitation of the iron. Any ferrous oxide which may have passed into solution is converted into ferric oxide by careful addition of chloride of lime, followed by the addition of lime, which precipitates the iron. Arsenate of iron is at the same time also precipitated if arsenic is present. Should the temperature of the solution exceed 40°c. some nickel and cobalt are precipitated, as also is some copper.

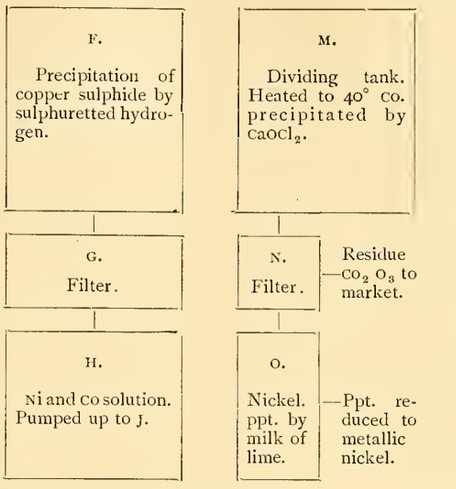
"Instead of an addition of lime as the precipitant, caustic soda or sodium carbonate is occasionally employed to prevent the precipitation of calcium sulphate when working with sulphuric acid solutions. Care must be taken to avoid using an excess of the precipitant, as the precipitation is a fractional one, and as soon as the iron has been precipitated, oxides of the other metals present begin to be thrown down.

"The next stage of the process consists in the precipitation of the copper. This is effected by raising the temperature of the solution to 70°c., and then precipitating the copper by the careful addition of either calcium carbonate, milk of lime, or a solution of soda. If an excess of the precipitant is employed, nickel will be thrown down. When a test with potassium ferro-cyanide shows that the whole of the copper has been thrown down, the cobalt is precipitated from the filtered solution by the careful addition of a solutionn of chloride of lime to the perfectly neutral, hot and not too dilute filtrate. If too much chloride of lime is added the precipitate becomes nickeliferous, and this must be carefully avoided. The nickel is next precipitated either by calcium carbonate, milk of lime, or soda. The nickel hydrate is filtered, dried, heated with sodium carbonate, to decompose any calcium sulphate that may be present, washed with acidulated water, and finally dried and reduced by carbonaceous materials to the metallic state.

"This process being dependent on the fractional precipitation with the same precipitants of the several metals present in the ore or metallurgical product under treatment, is frequently subject to slight alterations of procedure, and the following is a description of the process as carried out at a works in the United Kingdom:—

WET PROCESS FOR EXTRACTING NICKEL AND COBALT.


A. Calcined ores or speise of nickel and cobalt.
B. Granite jar for containing H. Cl. Steam passed in.
C. Precipitation of iron and arsenic by milk of lime after peroxidizing the ferrous oxide by $CaOCl_2$. Steam passed in.
D. Filter.
E. Solution. Pumped up to F.
J. Solution carefully mixed with metallic iron, chalk and chloride of lime. Steam passed in. Sulphuretted hydrogen evolved.
K. Filter.
L. Stock tank. Solution pumped up to M.


F. Precipitation of copper sulphide by sulphuretted hydrogen.
G. Filter.
H. Ni and Co solution. Pumped up to J.
M. Dividing tank. Heated to 40° co. precipitated by $CaOCl_2$.
N. Filter.
Residue —CO_2 O_3 to market.
O. Nickel. ppt. by milk of lime.
—Ppt. reduced to metallic nickel.

"About 3 cwt. of fine ore or speise A that has been thoroughly roasted is charged with hydrochloric acid in granite jars, into which steam is passed. The mass is kept boiling for twelve hours. It is allowed to settle and run off into tubs C. Steam is conducted into the tubs, and when the liquid begins to boil, bleaching powder (chloride of lime) is added to peroxidize the iron, and the mass is allowed to boil for about three hours. The arsenic and iron come down together. If no iron be present in the solution some must be added. The liquid is then run off through filters D, to underground tanks E, whence it is pumped to tanks F, in which the mass is treated with sulphuretted hydrogen. Adjoining these tanks, of which there are six, there are also three lead retorts, in which sulphuretted hydrogen is produced. In these tanks the copper is precipitated and the nickel and cobalt solution is strained through filters G, and drains into a second underground tank H. It is then pumped into a tank J, and there successively mixed with iron, chalk, chloride of lime, and water from tubs placed above the tank, with a view to precipitate first, any copper that may have passed into solution during filtration, and then the iron which has taken the place of the copper. The charge is first boiled by the aid of steam pipes so as to expel the sulphuretted hydrogen. It is then run off to a tank L for stock. It is next pumped up into a dividing tank M, and heated with chloride of lime, the cobalt being precipitated as oxide at a temperature of 40°. The solution containing nickel is allowed to run off into another tank O, in which milk of lime is added, and the nickel precipitated as hydrate oxide. The liquid is allowed to run off as waste. The oxides are pumped into presses, and the water is drained off. The nickel oxide is dried on the roof of a muffle, heated and crushed. It is then mixed with charcoal and heated in a crucible in a reducing furnace for eight or twelve hours. A rough powder is obtained and in this form the metal is sold, or the nickel oxide is mixed into a paste with flour and water, which is heated and cut into cubes. These cubes are placed in crucibles with charcoal and heated to a temperature above the melting power of copper. The nickel oxide is reduced by the charcoal and by the carbonized flour. The metal does not melt, but preserves the form of cubes. The cobalt oxide is removed from the dividing tanks to stone jars and treated by a process similar to that described so as to remove the last trace of nickel. The cobalt is finally sent to the market in the form of oxide." §

It will be readily understood from the complexity of this process that it must be an expensive one; hence the high price which fine nickel has maintained. But there are various methods of the wet process, some of which are of recent invention, and possibly the cost of production may be somewhat reduced by them. One of these is soon to be tested at the village of Port Colborne at the head of the Welland canal, where advantage will be taken of the supply of natural gas there for fuel. Gypsum supplied from mines in the adjoining County of Haldimand is to be largely used under this method, and hope is entertained that the sulphuric acid obtained as a bye-product will very considerably reduce the cost of producing the refined metal. The results of this method are awaited with much interest.

As to dry processes, including reduction of oxide by carbon in furnaces or crucibles and concentration in sulphide or arsenide and subsequent smelting in reverberatory or blast furnaces, there doos not yet appear to be absolute certainty that such methods can be successfully and economically applied to the treatment of nickel ores through all stages to the refined metal; but the metallurgy of nickel is so recent a subject of investigation and experiment that no one will be so bold as to say that the last word has been spoken upon it.¶

§ An Introduction to the Study of Metallurgy pp. 268-71.

¶ While this report is going through the press an interesting correspondence is being carried on upon this subject in the *Engineering and Mining Journal* of New York, between Robert M. Thompson, President of the Orford Copper Company, and Dr. Stephen H. Emmens, President of the Emmens Metal Company. The following letter from Mr. Thompson, is printed in the *Journal* of June 17th: "In your issue of June 3rd, I note a very interesting letter from Professor Emmens, headed 'Nickel Winning,' in which he says, 'No wholly dry process hitherto employed is capable of separating cobalt, or even (to a thoroughly satisfactory extent) copper, arsenic and manganese from nickel;' and referring to the Canadian pyrrhotite ores, 'The metal produced by dry methods from such a raw material is not fitted for fine uses.' In reply let me say that the following assays were made by the same chemist for nickel: Wharton's grain nickel, 99.39 per cent.; Martino's disc nickel (finest foreign nickel), 99.06 per cent.; Orford nickel, produced by exclusively dry process from Canadian pyrrhotite ores, 99.23 per cent. As to the quality of the Orford nickel, while I do not claim it is yet as perfect as we hope it soon will be, yet one of the largest consumers of nickel in the country writes me: 'In some respects your nickel is superior to any we have ever used. The metal is very white and remarkably soft and ductile, both of which points are of the greatest value.' Knowing Professor Emmens' interest in the metallurgy of nickel, I am sure he will be pleased to see what progress has been made in the dry process for treating this metal." But notwithstanding this assurance, Dr. Emmens does not appear to be wholly satisfied as to the merits of the process.

PRODUCTION AND PRICE.

Seventeen years ago, nickel in the United States was worth $2.60 per pound. Twelve years ago it had fallen to $1.10, the New Caledonia mines having been discovered and opened in the interval. At that time the world's yearly production of nickel was about 1,000 tons. Last year the price fell in the United States to fifty cents per pound, and in Great Britain to 42 cents. But the world's production had then increased to 6,000 tons, of which Ontario produced about one-third and New Caledonia two-thirds. Should increase continue at the same rate for the next ten or twelve years we shall doubtless see great activity in mining, smelting and treating operations in this province, especially should improvement continue to be made in processes, and prices fall as a consequence. It will not be surprising if in less than ten years prices have fallen to 25 or 20, or even 15 cents per pound, and in that event a large increase may be expected to take place in consumption. Assuming that no larger or better deposits of the ore are discovered elsewhere, what are the prospects of nickel mining in this Province in the event of a growing demand? The answer to this question may be found possibly in the words of the last United States Census Report on Mineral Industries. Referring to nickel and cobalt mining in that country in 1889, the writer says the great feature of the year was "the diversion of all attention in nickel mining to the nickel-bearing copper ores of the Sudbury region in Canada;" and he goes on to say: "The course of development showed conclusively that nickel can be produced there for a less cost than anywhere else in the world, so far as the present capacity of the known mines permit of an opinion." And referring to the New Caledonia mines farther on the same writer says; "At present the mines are less influential than those of Canada, for although the ores are fully as rich, labor is not so good, and for imported laborers the climate is bad. The ores are found in v-shaped pockets in serpentine, which is found over two-thirds of the island. Many of the pockets are large, but narrow with the depth. The cost of mining is considerble, and the transportation facilities to the sea coast are poor. It is not probable that the mines can compete successfully with the Canadian." *

Whether the working of manganiferous iron ores on that island containing cobalt and nickel will or will not change the condition in its favour cannot yet be foreseen, but it is hardly probable. Nearness to market, abundance of ore, and a supply of competent free labor and facilities for quick transportation are advantages which the Sudbury district is likely to continue to possess over its New Caledonia rival for all time.

THE FUTURE OF NICKEL.

The future of the nickel industry depends on the distinctive utilities of the metal, on the quantity and cost at which it can be supplied to consumers, and in a less degree on the quality of appearance. Twenty years ago pure nickel was not known in the arts; up to that time it was nothing more than an alloy with other metals combined with it in the ores, from which at best it was only imperfectly separated; and it was not indeed until after the pure metal began to be produced—the first examples of which were shown by Joseph Wharton at the Philadelphia Exposition of 1876—that its most valuable uses began to be found out. Some of these will be mentioned here as evidence of the growth of the nickel trade, and as an indication of the lines upon which it is likely to develop.

The experiments conducted four years ago by James Riley, of the Glasgow Steel Works, with alloys of nickel and steel, made a profound impression when the results were published; and although this may not prove in time to be the most valuable or useful of all the applications of the metal, it is the one which at present most strongly arrests attention in America. The explanation of this fact is found in the tests which, during the last three years, have been carried on by the Navy Department of the United States to determine the sort of material for armor best suited for the battle ships under orders of construction by the Government of that country. Mr. Riley's paper, read at the May meeting of the Iron and Steel Institute in 1889, contained no more than a speculative suggestion of the application of nickel steel to the armor plating of ships, but Secretary Tracy of the United States Navy Department regarded the promise held out as "too great to be ignored by a government requiring 20,000 tons of armor for its new fleet." Accordingly he began a series of trials to prove the suitability of nickel steel for the purpose in view, and not only so but to settle the question of the best armor plate in relation to the best ordnance—the strongest defence to match the most powerful attack. The following extract from the Secretary's report for 1891 shows the progress of the trials up to the close of that year:—

* Report on Mineral Industries in the United States, at the 11th Census, 1890, pp. 269-71.

ARMOR PLATE TRIALS IN THE UNITED STATES.

"The experiments made last year at Annapolis, described in the annual report for 1890, consisted of a test of the two principal foreign types of armor, the English compound plate and the French all steel plate, and an entirely new plate also made in France upon the special order of the department, of nickel steel. The result of the trial showed that the compound plate was decidedly inferior, and that as between nickel steel and all steel the former had distinct and positive advantages, the all steel plate being broken into four pieces, while the nickel plate remained absolutely uncracked.

"A series of tests made during the following spring and summer confirmed the conclusions formed at the Annapolis trial as to the superiority of nickel steel, and the department accordingly decided to adopt it, and made arrangements with the contractors looking to that end.

"It remained however to give a thorough trial to the first armor of domestic manufacture before beginning to place it upon the vessels, and for this purpose it was decided to order typical plates which should be made the subject of an experimental test. This trial was to ascertain two points: first, whether our domestic manufacturers could produce an armor that would stand competition with the material manufactured abroad; and second, which of the various modes of treatment suggested would give the best results. In reference to the latter point the questions to be considered were the relative merits of rolling and forging in the manufacture, and the effect of a new method of treatment, named from its inventor the Harvey process, designed to harden the surface of the plate while retaining the toughness of its body.

"Of the six plates tried three were furnished by the Bethlehem Iron Co., and three by Carnegie, Phipps & Co.

"In these trials, which took place at Indian Head on October 31 and November 14, the plates were subjected to tests more severe than had been applied at any foreign government trials. Four shots were fired at each plate from a 6-inch gun with an impact velocity of 2,075 feet per second, and an energy of 2,988 foot tons, using the Holtzer projectile of 100 pounds. One shot was then fired at the centre of each plate from an 8-inch gun, with an impact energy of 4,988 foot tons, using Firminy and Carpenter projectiles of 210 and 250 pounds weight respectively. The plates were placed normal to the line of fire..

"The results of the trial were in the highest degree satisfactory. Each of the six plates manufactured in this country was superior to the English compound plate, while the nickel Harveyed plate and the high carbon nickel plate were superior to all the foreign plates of the Annapolis trial. They may therefore be pronounced in advance of the best armor hitherto manufactured in Europe.

"Further light was thrown upon the question of the relative merits of all steel and nickel steel armor, and any doubt which may have remained upon that subject was finally set at rest. Of the three plates made by Bethlehem, two were of nickel steel, one treated by the Harvey process, the other not, and the third was of all steel, Harveyed. Both the nickel plates proved to be far superior to the all steel Harveyed plate, notwithstanding the advantages which it may have derived from the special treatment; and both proved superior to the French all steel plate tried at Annapolis.

"A third nickel plate, manufactured by Carnegie under the rolling process, also showed a marked superiority over the all steel plate of this year, and both it and the corresponding Bethlehem plate manufactured under the hammer showed a capacity of resistance to perforation fully ten per cent. greater than that of the French all steel plate. In this respect the results furnished by the two American plates manufactured by the different processes (forging and rolling), proved to be remarkably uniform, the 6-inch shots that were fired at them differing in penetration but an inappreciable amount.

"The trial thus definitely establishes the fact that armor of excellent quality may be produced by the rolling process, and that forging by means of the hammer, the greatest source hitherto of expense in manufacture, is no longer to be regarded as an absolute necessity. The importance of this fact can hardly be over-estimated, for it raises a probability that within a year or two the armor-producing capacity of the United States may be quadrupled in case of necessity, and that if we had 10,000 tons to let and could give 18 months from date of contract to commence delivery, the cost of manufacture would be reduced from 25 to 33 per cent., while the work hitherto confind to two firms would be thrown open to a large number of competitors.*

In his report for 1892 Secretary Tracy reviews the steps which had been taken by his department for the development of armor, and after special reference to the trials at Indian Head in October and November, 1891, he goes on to say:—

"As a result of this trial improved methods were introduced in the Harvey process and further tests were ordered of new plates. The first of these tests took place July 26, 1892, at Indian Head. The plate used was a 10½-inch plate of nickel steel made by the Bethlehem Iron Company, the plate having first been forged to 12½ inches and then Harveyed, and finally reforged to its former dimensions. In the two previous trials the corner shots had been fired from the 6-inch gun, and the 8-inch had been used only upon the centre of the plate. In this trial the 8-inch was used for all the shots. The result was that three of the projectiles were broken up upon the surface of the plate, while the two right hand shells penetrated to a depth of 13 inches. It was evident that there was a want of uniformity in the hardness of the surface, and that some special cause must have softened the right hand side of the plate. Upon investigation it became apparent that this was due to the process of reforging, resulting in a lower temperature and consequently reduced carbonization upon this side of the plate. Notwithstanding the penetration of the two right hand shots, the result by which the plate had remained free from cracks after receiving five blows from 8-inch projectiles was an extraordinary confirmation of the expectations that had been formed as to the possibilities of nickel steel treated as described.

"It remained for a final trial to demonstrate the wisdom of the steps which had been taken, and to crown the efforts of nearly four years with the highest degree of success.

"This trial took place at the proving ground of the Bethlehem Iron Company, July 30, 1892. The plate was of nickel steel, Harveyed, of the same thickness (10½ inches), as that of the previous trial, but unlike its predecessor it had been forged to its final thickness before the Harvey process was applied. As in the previous trial the 8-inch gun was alone used. Five Holtzer forged steel shells, weighing 250 pounds each, with a striking velocity of 1,700 feet per second, and each with an energy of 5,000 tons to the square foot, were fired at the plate at a distance of 30 yards.

"Never before these trials had any armor plate in the world been subjected to such a test as was represented by these five blows of a total energy of 25,000 foot tons.

"The result may be told in a word. All five of the projectiles were smashed upon the surface of the plate. The plate showed no signs of injury further than the opening of a slight temper crack four inches in length from one edge, and a wale less than one inch in thickness on the back of the plate opposite each point of impact. The striking ends of the projectiles appear to have been splashed on the face of the plate, filling the slight indentation made by the blow with new material which became welded to the substance of the plate itself and left it as before a flush surface. The remainder of the projectiles could only be found in the shape of innumerable scattered fragments.

"The result above described has never been equalled or even approached before by any armor plate, American or foreign. It has demonstrated that the United States, in the reconstruction of its new navy, which ten years ago had no existence even on paper, is enabled to place upon each and all of its armored vessels a material the like of which the world up to this time has not seen; and that while vast sums have been spent in plating the sides of foreign men-of-war with an inferior material, this country will employ for the purpose an armor which is not only far more efficient, but which represents unquestionably, having reference to the dimensions of plates thus far tested, the highest development of modern science, and a development reached by its own independent efforts."*

As early in the course of these trials as September, 1890, the Secretary of the Navy was so well convinced of the superiority of the nickel steel plate that he asked and obtained from Congress an appropriation of $1,000,000 for the purchase of nickel matte. At this time an apprehension existed in the minds of United States authorities that the world might not be able to produce enough nickel for their wants, and they feared that prices would take a bound upward. They accordingly purchased from the Canadian Copper Company 4,536 tons of matte, containing about 900 tons of nickel. "The terms of the contract provided that the material should be delivered on board cars at Sudbury, Ontario, for transportation to such points as might be designated. Deliveries were to begin within three days from the date of the contract, and final deliveries were to be made within one month thereafter. Provision was made by means of competent assayers for ascertaining the quantities of nickel and copper contained in the matte, and that no carload should be shipped in which there was less than an average of 15 per cent. of nickel."† The payments to the Canadian Copper Company for matte amounted to $321,321.86, while freight cost $31,134.88, duty on the copper contents $9,547.40, and refining by the Orford Copper Company (in part estimated), $97,582.30, making a total expenditure under the appropriation of $459,586.44. "Of the nickel oxide produced by the Orford Company, by whom the refining is done, we are now using 40 per cent., while 60 per cent. is sold in Europe. Our material, after the payment of all charges, including the price of the matte and of the subsequent reduction, costs us 24 cents a pound, while that of other consumers costs them at least 38 cents."‡ But this is the cost of the oxide. The quantity of armor plate required for an ordinary war vessel such as the United States is constructing is about 3,200 tons, and as the contract with the makers calls for only 3¼ per cent. of nickel in the plate, the quantity of nickel used for one vessel is only about 104 tons, or say 135 tons of nickel oxide. Obviously therefore there is a modest limit to the quantity of nickel required for the manufacture of armor plate for the United States navy, unless the government of that peaceful republic should seek to emulate the naval greatness of all the European powers, which is as improbable as that she should follow their example in the creation and maintenance of a standing army.

NICKEL STEEL FOR HEAVY ORDNANCE.

But there is some likelihood of nickel steel being used in the manufacture of heavy ordnance as well as for armor plate, and at the present time experiments are being conducted to test its suitability for that purpose. The following extract from a lecture delivered before the Franklin Institute, of Philadelphia, last January, by Mr. W. H. Jaques, Ordnance Engineer, will show what is being attempted as well as what has been done in this direction:

"The increasing use of nickel in steel suggests a few words concerning this element, particularly as it is about to make its debut in a large calibre service gun (a thirty-five calibre eight-inch B.L.R.), the forgings for which have been made by the Bethlehem Iron Company.

"In this connection it is most seriously to be regretted that circumstances of a discouraging character should have intervened to prevent Mr. Riley's continuing the excellent metallurgical work he so happily and ably commenced in connection with the alloys of nickel and steel, particularly since the publication of his lecture to the Iron and Steel Institute, May 4, 1889, so many of his views have been proved by further experience and practice.

"Bethlehem's part in this work is so well known by the practical results she has obtained, the gun forgings and other products supplied, and the superior resistance of her armor, that I need make no detailed statement here of our accomplishments. Further, they have already been referred to by the chiefs of the Bureaus of Steam Engineering and Ordnance in their last annual reports.

"As you will no doubt recall, Riley, Dick and Packer commenced their experiments with samples of French crucible nickel steel, containing three per cent., five per cent. and twenty-five per cent of nickel; were subsequently assured by personal investigation that the desired products could be obtained with certainity, not only in the crucible, but with perfect control in the open hearth, and that nearly all the nickel would be found in the steel. Riley, in the lecture referred to, described the action of the steel in the mould, its appearance, value of scrap, and the care and temperatures required to work it. He made a sufficient number of tests to show the marked increase of tensile strength and elastic limit produced by certain increments of nickel without impairing the elongation or contraction of area to any noticeable extent. He pointed out the effects of a variation of the proportions of carbon and manganese with the same percentage of nickel, the point where the increment of nickel changed its hardening influence to one of softening ductilizing, its neutralizing effect upon carbon, the difficulties of machining, and crowned his report by giving due credit to the patentee, French steel makers, his assistants and the authorities.

"Together with other conclusions he said: 'I am glad to be able to state that before the region of extreme difficulty of machining is reached, we have qualities of nickel steel available which will be of the utmost value for a very large number of purposes.'

"Comparing ordinary steel with nickel steel, he adds: 'I think there will be no hesitation in deciding that there will be a very great advantage gained by the use of the latter—advantage either in reduction of scantling or in increased strength and ductility. In the very important matter of corrodibility, it is with the greatest satisfaction I can state that the steels rich in nickel are practicably non-corrodible, and that those poor in nickel are much better than other steels in this respect. Some samples of the richer nickel steels which have been lying exposed to the atmosphere for several weeks will show an untarnished fracture.'

"These experiments to test the non-corrodible qualities of the various percentages of nickel steel, it will be remembered, were made in connection with Abel's corrosive liquid and hydrochloric acid water.

"I have cited Riley's conclusions to show how accurately they have been verified by the results since obtained, which give abundant testimony of the care and faithfulness with which his experiments were made.

"Mr. Hall, of Sheffield, claims to have made the first nickel steel gun, which instrument is reported to have burst at the first round, the rupture being due to the absence of suitable transverse strength. Whether this was due to the poor steel, poor construction, or the presence of nickel, was not stated.

"Many other nickel steel guns have been experimented with, but Krupp's comparative tests of two three and a half inch field guns, one made of ordinary Krupp steel and the other of nickel steel, appear to be the first trials of much importance that have been given publicity.

"Each gun was loaded with shell containing 170 grammes of picric acid, the centre of the shell in each case being 300 millimetres from the muzzle.

"When the shells were exploded the crucible steel gun burst into many pieces, while the nickel steel gun remained entire, showing an increase of the bore of 7.4 millimetres at the site of the projectile, but no cracks anywhere.

"The trial was continued with another shell containing 180 grammes of picric acid. Its explosion caused an enlargement of 9.50 millimetres and a longitudinal crack 80 millimetres long. No particle of metal was detached from the gun."*

*Report of the Secretary of the Navy for the year 1891, pp. 11-13.

*Report of the Secretary of the Navy for the year 1892, pp. 17-19.

†Secretary's Report for 1892, p. 21. The first contract appears to have been for 536 tons, and the second, under date of June 15, 1891, for 4,000 tons.

‡Secretary's Report for 1892, p. 21.

*Present Development of Heavy Ordnance in the United States, by W. H. Jaques, pp. 25-27. Lieutenant Jaques (who has served 21 years in the U. S. navy), is the author of a valuable essay on "The Establishment of Steel Gun Factories in the United States," published in the Proceedings of the United States Naval Institute in 1884 (pp. 527-909). It was largely upon his recommendations that the Government of the United States undertook to promote the manufacture of armor plate and ordnance at home instead of depending for supplies upon European makers, and when the Bethlehem Iron Company six years ago resolved to undertake the manufacture of guns, shafting and armor plates, the position of Ordnance En-

In connection with the foregoing extract from Lieut. Jaques' lecture, the following account from the *London Iron* of further experiments by Herr Krupp are worthy of notice (unless indeed it is only a different account of the same experiments):

"A new nickel steel, the secret of the manufacture of which has been secured by Herr Krupp, of Essen, has been experimented with at Meppen. Two 3.4 inch shells, each containing 6 oz. of picric acid were placed, one in a gun of ordinary Krupp steel, and the other in a gun of the new nickel steel, at a distance of 12 inches from the muzzle. Upon the shells being exploded, the muzzle of the gun of ordinary steel was blown into a number of pieces, but the only effect produced upon the nickel steel gun was a local enlargement of the bore to the extent of a quarter of an inch. In the next experiment a 3.7 inch shell, containing 6.3 oz. of picric acid, was burst in a nickel steel gun at a point 19.5 inches from the bottom of the bore. The results were an enlargemeni to the extent of one-third of an inch and a fissure of three inches in length. Trials of plates of this nickel steel have also been made and are stated to have given satisfaction."*

It is not improbable therefore that nickel steel will soon be utilized in the making of heavy ordnance as well as armor plate; and the frequent accidents which have recently occurred in the breaking of shafts of the great ocean liners will doubtless suggest the manufacture of shafts, cranks, and indeed all important parts of the machinery of passenger ships, as well as battle ships of nickel steel.

ARMOR PLATE IN EUROPE.

We know much less of the purposes to which nickel steel is applied in Europe, for the reason that the governments of that continent are much more secretive in the trials they are carrying on than is the Government of the United States. A year ago the British Secretary for the Admiralty informed Parliament that nickel steel had been experimented with largely, that extensive orders had been placed for nickel steel armor forming the secondary defence of battle ships now in course of construction, and that several are fitted with this kind of armor, which has been proved sensibly superior to ordinary steel when used in thicknesses of three or four inches. But the officials of the British Admiralty have been much slower to acknowledge the superiority of nickel steel for armor plate purposes than were their brethren in the United States, although the first suggestion of the usefulness of the alloy for this purpose was made by James Riley. But the astonishing results obtained in the United States last year at Indian Head and at the Bethlehem proving grounds could not any longer be ignored, and on the 1st of November a test was made at Portsmouth on board the target vessel Nettle. Up to this date tests in Great Britain had been confined to all steel and compound armor plates manufactured by English makers; but in this instance the experiment possessed a two-fold novelty, the plate submitted to the ordeal being of a nature new to Europe and having been manufactured in accordance with an American patent. The London *Engineer* furnished this account of the trial:

"The plate was made of high carbon nickel steel Harveyized, or Harveyed, by carbonizing the face and hardening it with jets of water. We may state at once that we are not in a position to report trials of this class from independent observation. The series of trials on board the Nettle are carried out by Admiralty officers, and are in all respects trustworthy; but in the interest of makers who in various stages of these trials might submit plates of an entirely experimental character, no officer or other official is allowed to treat the results as public property. In point of fact they are regarded as confidential unless the manufarturers wish to publish them themselves. There is we think no reason to find fault with this system. Certainly manufacturers have been thereby encouraged to make experiments which they might otherwise shrink from attempting, and although doubtless the effect must be that the public hear only of successful results they hear of them on trustworthy authority, and a very fair idea is obtained of all such work as is sufficiently good to be admitted into the service; and this is what mainly concerns the public, and when the photographs officially taken are published little is left to be desired as to completeness of information.

"The trial in question is an important one. Photographs of the best Harvey plates tested in America have been printed by us. We pointed out then that the shape taken by the remarkable result achieved was the holding together of the plate under the wedging strain of five 8-inch projectile heads, which penetrated to a considerable depth. In fact, the hard face due to the Harvey process caused the projectiles to break, and though the heads had impressed energy enough on the plate to penetrate to a considerable depth the plate, as we suggested, probably thanks in a great measure to the nickel in its composition, held wonderfully well together. Tresidder's plate, which was naturally compared with it, performed a slightly different feat. It broke up 6-inch projectiles in its face with very insignificant penetration. Thus the projectiles were more completely defeated, but they were much smaller. The Tresidder plate, be it observed, was in consequence of the complete defeat of the projectiles not submitted to the wedging strain which fell on the Harvey plates, and there is no evidence as to how it would have behaved under it.

"Clearly the link required from Harvey's point of view was to show that the plate face was capable of defeating the lighter 6-inch projectiles with as little penetration as in the Tresidder plate. This was needed, for the last Harvey plate attacked by 6-inch shot had certainly allowed their points in two cases to penetrate deeply; one side of the plate was in fact softer than the other. There was an explanation for this, but no explanation is as good as a successful performance. The success at Portsmouth therefore is, we venture to think, just what we want at the present moment, and we are endeavoring to obtain permission to publish the photographs, which as yet we have not obtained.

"A competitive trial at Ochta, near St. Petersburg, is expected to take place shortly, when the Harvey, Tresidder, St. Chamond and Schneider plates will be tested in a strictly comparative way by 6-inch forged steel Holtzer projectiles, fired with about 2,000 feet velocity. The Nettle trials consisted of an attack of three 6-inch Holtzer and two Palliser chilled iron shot, striking at a velocity of about 1,976 feet per second. The Palliser projectiles are expected to break up as a matter of course with comparatively slight effect. It is only latterly that the Holtzer shot have been similarly defeated. In the present instance they have, we understand, broken into small fragments with but little penetration."*

Another account was published in *Iron*, and this paper, after citing the statements of the U. S. Secretary of the Navy and the Chief of the Bureau of Ordnance on the trials conducted under their direction, went on to say:

"However much these positive statements might be discounted, it was impossible for the British Admiralty, considering the official authority on which they were published, to discredit them entirely. It consequently determined to submit them to a practical test, and with this object in view, it entered into negotiations with the agents of the Harvey Steel Company of New York. Eventually Messrs. Vickers & Co., of Sheffield, were commissioned by the Government to manufacture a nickel steel plate and to treat it according to the the Harvey process, by which extraordinary hardness is communicated to the surface, together with a proportionate amount of toughness, so that the increased brittleness which commonly attends the hardening of steel is prevented. This was the plate that was tested on board the Nettle. The experiment was in no sense a manufacturer's, but an Admiralty test. It is the only trial of a Harveyized plate which has yet taken place in Europe, for although a similar plate has been manufactured by the same makers for the Russian Government, it will not be fired at until next week.

"The trial, which was conducted by Captain Hugo Pearson, of the Excellent, was witnessed by W. H. White, C.B., Director of Naval Construction, Admiral Colomb, General Geary, R.A., Captains Jenkins and McKechnie, of the Ordnance Committee, Colonel W. W. Barlow, late of Woolwich arsenal, and other officials. The Harvey Steel Company was represented by Mr. Edwin W. Fox and Mr. Joseph H. Dickinson, of New York, and the manufacturers by Messrs. Albert and Thomas Vickers. The plate measured 6 feet by 8 feet, with a thickness of 10½ inches. Its dimensions were consequently the same as those of other sample plates tested on board the Nettle, and though the representatives of the steel company expressed a wish that it might be attacked by a gun of larger calibre and greater ballistic properties than the one usually employed, the test for purposes of comparison was of the ordinary character consistent with Admiralty conditions. This consisted of discharging five rounds at the target from the six-inch breech loader. The charge was 48 lb E.X.E. powder, the weight of projectile 100 lb., and the muzzle velocity 1,975 feet per second. The rounds were fired in the following order: (1) Holtzer steel shell at bottom right-hand corner; (2) Holtzer at upper left-hand corner: (3) Palliser shell at upper right-hand corner; (4) Palliser at lower left-hand corner; (5) Holtzer in the centre.

"The result of the firing was an astonishing success, and completely verified the accuracy of the reports received from America with reference to the merits of the Harvey hardening process. Contrary to ordinary experience the Palliser projectiles appeared to do as much execution as the French shells, for although they splashed upon the plate on impact they made indents of about 1½ inch in depth. The Holtzers, on the other hand, appeared to weld their points into the target before bursting into a thousand incandescent fragments. Every one was completely pulverized. The most remarkable feature of the trial however was the fact that the plate withstood its punishment so well that not a single crack was produced -- a quite unprecedented circumstance in armorplate experiments. Further trials with thinner plates are to be prosecuted at Portsmouth, and should these prove correspondingly invulnerable many of our obsolete armorclads might easily be brought up to date by superseding their thin iron protection by the new armor of equal thickness and weight, but of greatly superior impenetrability."*

It is not known what decision, if any, has been reached by the British Admiralty authorities with respect to future construction, following this trial of armorplate on the Nettle, but it is not likely that the value of the lesson will be wholly lost. The *Engineer*, in commenting upon the First Lord of the Admiralty's memorandum on the naval estimates for 1893-94, says: "Doubtless advantage will be taken of the increased resisting power to penetration afforded by the Harveyized nickel steel plates; and, as a diminished thickness of armor can now be carried, it will probably be distributed over a greater area. We have slowly but surely been emancipating ourselves from that curious predilection for a small patch of enormously thick armor, of which the Inflexible was the earliest example."†

It is not likely that a pre-eminently naval power like Great Britain, which is now expending over $70,000,000 a year to maintain a navy adequate to her requirements, and building battle ships at a cost of $3,000,000 to $4,000,000 each for those of the first rank, will long be content to use any other than the best of material. Nickel steel plate will cost more than all steel plate, perhaps much more; but it will in part make up the extra cost in greater lightness and increased efficiency, and in the construction of battle ships efficiency is the point of first consideration. Referring to the cost of nickel steel armorplate to the United States Government, the *Engineering News* of New York, says:

"Prices obtained for armor plates by the Carnegie and Bethlehem steel companies, who are the only manufacturers in the country, may well excite the envy of steel makers who hunt for customers for best structural steel at prices under $40 per ton. Bids were opened on February 5th at the Navy Department for about 7,000 tons of nickel steel armor plate. The prices bid by the two firms ranged from $520 to $885 per ton for the different sizes and kinds of plate specified. About $56 per ton extra is asked for treating the plates by the Harvey process. Making a very liberal estimate for the cost of manufacture, it looks as if the profits on this order alone ought to go a long way toward repaying both the companies for their original expenditure on their armor-making plant. It is of interest to notice also that at an average price of $600 per ton, the armor for the new line battle ship Massachusetts will cost about $1,225,000. The total cost of the vessel was estimated at $3,020,000."

The total quantity of armor plate required in the construction of this ship is 2,042 tons, the nickel contents of which would be at 3¼ per cent. (if gross tons are meant), not quite 150,000 pounds. Assuming the price to be 50 cents per pound, the cost of nickel contents in the plate will not exceed $75,000 (or $46,750 at the cost of nickel oxide). Unless then the cost of making nickel steel is vastly greater than of other alloys the question of cost of nickel steel plate will not long stand in the way of its adoption by governments which are persuaded of its superiority. Nor is it likely that the Carnegie and Bethlehem works will long continue to enjoy a monopoly of supplying this plate to the Government at $600 per ton.

The tests conducted by the Russian officials at Ochta were made upon one French and two English steel plates and a Vickers-Harveyed nickel steel plate, and in commenting upon this trial the London *Engineer* reports the latter "to have altogether beaten its competitors."‡

With all this evidence to demonstrate the value of nickel as an alloy with steel in the construction of war ships, the chances would appear strongly to favor its being so used by the navy building powers. Yet the demand for the metal would not be enormously increased if all the navies were to be reconstructed with nickel steel for armor plate; it would not be necessary perhaps to more than double the present production.

OTHER USES FOR NICKEL.

Whence then is an increased demand for nickel likely to arise? What other purposes give greater promise of consumption than the making of armor plate and ordnance? A few of these may be indicated.

As an alloy of steel the greatest use of nickel may be found in the making of boilers, engines and locomotives and structural material generally, where it is of vast importance to combine lightness and strength. In a large Atlantic liner, for instance, the plates of the boilers are one and a half inches thick, and enormous force is required to bend and rivet them, in which operation the plate is likely to be weakened by fracture, the lines of

gineer was offered to Lieut. Jaques. The object of the Company was, as stated by Mr. Jaques in an article descriptive of the works, published in the Proceedings of the Naval Institute, "to erect a plant long needed in the United States to make the country independent in the possession of the means of supplying the nation with the most powerful guns, and of equipping her ships with the most efficient shafting and armor." To this end a number of new and large buildings have been erected on the Company's grounds along the Lehigh river, which have been furnished with the best of modern machinery, and new buildings are still going up, which, when completed, will no doubt make the Bethlehem works the largest in America. Upon a visit to Bethlehem last October, I was shown through the various departments by Mr. Jaques, and a note of the armor plate and ordnance branch of the works may be fittingly made here. Four Siemens open-hearth furnaces are employed in the production of nickel steel, two of which have a capacity of 40 tons each per day of twelve hours, one of 20 tons and one 10 tons. The process of alloying the metals is claimed to be a company secret, and to give better results than is obtained elsewhere. During my visit the 20 ton and one of the 40 ton furnaces were tapped and run into a mould, casting an ingot of 60 tons nickel steel. This contained 3¼ per cent. nickel, which is the Government requirment for armor plate, or a total of very nearly two tons (1.95). For a portion of the time the Siemens furnaces are employed in making all steel, the ingots of which are compressed into cylindrical shape by hydraulic power. Two of these, still warm from the press, were lying on cars ready to be taken to the forging shop. They looked like two great saw logs, being 4 feet 6 inches in diameter and 15 feet in length. The ingots are forged under powerful steam hammers into any required shape, some for armor plates, some for guns and gun casings, and some for shafts, cranks, etc. The armor plates are heated in low furnaces, forged flat, requiring frequent reheating before the process is completed, and afterwards shaped by hydraulic power and tooled by machinery. After being finished in this way they are fitted together on platforms so that when sent to the shipyards each piece is ready to be put into the place designed for it without further machining or shaping of any kind. The specifications are furnished by the Navy Department, and hardly any two plates of the same ship or of any two ships are alike. Many of the plates weigh 30 tons and upwards. The long guns are heated in an upright furnace, some of the forgings being 25 to 38 feet in length, and weighing 25 to 45 tons. They are forged under a steam hammer weighing 125 tons.

Iron, February 24th, 1893.

The Engineer, London (England), November 4, 1892.

Iron, London (England), November 4, 189 2.

†*Engineer*, March 10th, 1893, p. 211.

‡The *Engineer*, March 24, 1893, p. 256.

which are not always visible. If made of nickel steel alloy the plate would require to be little more than half the thickness, and while the boiler would be more easily and securely made, it would be but one half the weight—a very important item where there are twelve or thirteen huge boilers in the hold of one ship. Its strength would be as great, and it would be less liable to corrode. It would cost a little more, but its life would be lengthened.*

In the making of parts of locomotives and steam engines, as well as in the manufacture of cranks and shafting, nickel steel has also decided advantages over all steel. A locomotive is worth perhaps $100 per ton, and where the cost is so largely made up of the wages for labor, as it is in the case of a locomotive, a small addition to the cost of raw material is of little consequence. Many parts of locomotives, such as axles, of which everybody is so much afraid, tires, framework, etc., could be made of not much more than half the present weight and just as strong.

There is a considerable quantity of nickel being used now in Great Britain and the continental countries, but the trade is carried on quietly, and perhaps the only persons who could give information about it besides the manufacturers are the refiners, who generally know for what purposes their customers are using the metal. It is quite possible that locomotive tires are being made out of nickel steel in Germany, and doubtless a big trade will be done in that line. It seems likely that these German nickel steel tires are displacing the tires of English make, but if so it will not be long before Englishmen use the same material.

The British government has been using a large amount of nickel in one way and another, but chiefly in making experiments. A firm in Glasgow got an order eighteen months ago which took up 20 tons of nickel, and this would have been regarded as an unprecedented order ten years ago. But the British government is conservative of new methods, and its officials must be well persuaded before advising a change from good to better.

Twelve years ago, when the production of nickel was 1,000 tons and the selling price about $1.20 per pound, the chief if not only uses of the metal were for German silver, body for electroplating and for coinage. Its present uses include these, with the difference that coins are now being made of pure nickel instead of nickel alloy as formerly. The Austrian government intends to adopt it for this purpose, and it is rumored that they have given the French nickel company an order for about 3,000,000 pounds. It is only a rumor, but those who profess to know say that the company has received the order, and that it is probably for a larger quantity, spread over five or six years. Twelve years ago this French company refined 300 tons a year; to-day it is refining about 4,000 tons, having got the bulk of the expansion. It has gone on steadily improving its processes, and a great factor in cheapening operations has been the increase of production. But of course many blunders have been made. That is inevitable in dealing with any new enterprise of this kind, the details of which must be mastered experimentally. The producer of pig iron, copper, gold or any other of the staple metals, can usually sell his metal as fast as it is produced to some person or other. If the price is made a little less than market rates, some one will take it; but the man who produces refined nickel must hunt up his own customers, and they are few in number. The demand to-day is not so great as the supply, but so soon as the metal is produced at 35 or 36 cents per pound instead of 42 the consumption may be expected to grow rapidly. And no doubt it is possible to sell nickel at these prices if the requirements of the market would justify operations on a larger scale than appears to be prudent to enter upon now. A thoroughly practical man says: "I can lay my hand on a mine tomorrow that would show a splendid result at these figures, but it is not every mine that can do so."†

*Mr. Ian Cameron, Manager of the Dominion Mineral Company's works at Sudbury, informs me that it was through smelting New Caledonia ore, which is free from sulphur, that the first nickel steel was made. "Garnier had a high furnace similar to an iron blast furnace, and he put his nickel ore through that furnace and smelted it as if it was iron ore. Every particle practically of the iron and nickel in the ore was got out—though there was a pretty heavy loss of nickel and iron in the slag—and the result was a very good ferro-nickel, which led to the making of nickel steel by Mr. Marbeau, then one of the Directors of Le Nickel, who started the Ferro-nickel Company in France, at or near the German frontier. This company induced the Steel Company of Scotland to experiment with nickel steel, and Mr. Riley, the manager, told me that if it had not been for his company stopping him they would now be making all the boiler plate in Scotland of nickel steel. But the trade got brisk and the company had enough to do without experimenting.

In a recent communication, Mons. Jules Garnier, the French metallurgist, who has been prominently connected with the development of the nickel industry, gives the results of a number of tests made in September, 1892, at the Cleveland Rolling Mill Company's works, to determine the relative quality of steel with and without the addition of nickel. The two steels differed only in the amount of nickel added to one of them, the quantity being about three per cent. The method of manufacture and the charges of both heats were absolutely identical. The ingots for both heats were rolled into boiler plates under ordinary conditions. The tests show the following general results: (1) Nickel steel has on an average a higher limit of elasticity of 11,400 lbs. per square inch, or nearly 31 per cent. (2) Nickel steel has an ultimate tensile strength greater by 10,400 lbs. per square inch, or an increase of about 20 per cent. (3) The ductility is not reduced by the presence of nickel. The nickel used was made from Sudbury ores at the Brooklyn Nickel Works, near Cleveland, a refinery built according to the plans of Mons. Garnier.

†The New York *Engineering and Mining Journal* of May 13th, 1893, says: "One thing definite may be said, we think, about nickel. The decline in its price which has taken place during the last two years will be maintained, and in all likelihood it will go still lower. There has been recently an industrial revolution in this metal equal in importance to that which followed the opening of the mines in New Caledonia. The discovery of the Sudbury deposits, and the Orford process by which nickel-copper matte can be cheaply and successfully treated, have made America independent of the world for its supply of nickel, and it now threatens the European markets, the cost of production having been brought below that of the metal of New Caledonia. European metallurgists have not been standing still however, for an improved process, the invention of M. D. Levat, formerly Director-General of the Societe le Nickel, has already been put in operation at Havre, France. This is a dry process; indeed, it may be said that the day of wet processes for nickel winning is past."

The *Engineer*, of London, Eng., of January 6th, 1893, also says: "The remarkable discovery of the volatility of nickel in carbonic oxide, due to Mr. Ludwig Mond, is, according to a statement of the discoverer, to be utilized upon a commercial scale, but it is not known whether the works have as yet been started. The older processes of obtaining the nickel have been improved by the adoption of continuous reduction furnaces, instead of crucibles, and in other details without much alteration of principle, and particular attention has been paid to the production of ferriferous metal for steel makers by Mr. J. Garnier and others; the modern practice of nickel smelting so far as it can be made public having been treated in considerable detail by M. Levat. In consequence of the large supplies coming from Canada and New Caledonia, the price of the metal has continually declined in spite of the new demand in Europe for military purposes, about 500 tons per annum being now required for the bullet casigns in the new small arms ammunition. The alloy, one of nickel to four of copper, used for this purpose seems to possess many valuable properties, and it has been suggested as a substitute for copper in locomotive fire box plates."

Several years ago Mr. Wharton, of Philadelphia, as already mentioned, began the plating of material by rolling refined nickel into thin plates and then pressing or welding it on both sides of a sheet of iron or steel; but he does not appear to have developed this application of the metal into a regular business. The process gives a very good article, but it is a little troublesome. A slab of nickel and a slab of steel may be rolled together so as to show a steel face upon one side and a face of nickel upon the other; or nickel may be rolled upon both sides of the steel, and when planished it presents a very attractive appearance. But results almost equally good as regards appearance may be obtained by dipping or electroplating, and the rolling process has not therefore come into general use.

At the present time the most promising uses of nickel are for the manufacture of body for electroplating, and the making of white metal alloy, which does not require electroplating. If 25 or 28 per cent. of nickel is added to a white metal alloy the material is nearly as good as silver plate, and it can be kept clean with infinitely less trouble, besides being of uniform color and quality throughout the whole of its substance. A cheap electroplated article will cost as much as or more than a solid white metal one, and after the coating has worn it is an unsightly thing of patchy yellow. Door fittings if made of white metal would cost perhaps 10 per cent. more than brass; but they would always be bright and clean, and easily kept so. A gas bracket weighing 10 pounds, if made of white metal instead of brass, would consist of 2½ pounds of nickel and 7½ pounds of brass, the former costing $1.05 and the latter 75 cents, or $1.80 in all. There is perhaps $10 worth of labor on it; so that the increased cost through putting 25 per cent. of nickel into it would be only a fraction of the total cost, while a handsomer article and one more easily kept clean would be the result. Hotel bath and lavatory fittings, etc., are now being made of white metal, and one manufacturer in the old country is said to turn out $1,000,000 worth in a year. "There is a large trade growing up," a gentleman engaged in the production of nickel informs me, "in the displacing of brass for lamps, chandeliers, electroliers, door and railway carriage fittings, etc. White metal for these purposes is largely taking the place of brass. It is dearer, but it is ever so much brighter, prettier and easier to keep clean; it tarnishes very little and a light rub will restore its planished appearance, whereas brass requires continuous labor to keep it bright. I have seen a butcher's shop in the old country the walls of which were wholly lined with white tiles, and all the fittings, brackets, hooks and nails were of white metal. The effect as seen by gas light from the street was very fine, and it really enabled the butcher to add a little to the price of his beef. The white metal trade is the one we prefer."

Another use found for the metal in Europe is in the making of bullet casings for small arms ammunition. For this object an alloy of one part nickel and four parts copper has been adopted, and factories producing ammunition for military small arms are requiring now 500 tons of nickel annually in the manufacture of bullet casings alone.

No little misapprehension however prevails as to the demand for nickel. There are some who declare that there is no limit to the quantity which the markets are capable of absorbing, and that some cause of policy, or want of capital, or lack of enterprise is blocking the wheels of progress in the Sudbury mining district. If Sudbury was in the United States, we are sometimes told, the woods would be alive with prospectors, mining camps and smelting works; millions of capital would be invested there, millions of tons of ore would be raised and treated annually, refining works would be established, and Sudbury would supply the world with the pure metal. Such is the language of dreamers, and men who have mining locations to sell. But men who know the trade do not speak in that way; neither do men who have a knowledge of how industries grow. On this subject I have obtained a short statement from Mr. Ian Cameron, manager of the Dominion Mineral Company's works, and a man of large experience in nickel:

"The break in price which took place eight or nine years ago, when nickel fell from 2s. 6d. per pound to 2s.," Mr. Cameron says, "led to such an increase in the demand that we could not supply it. When I built the old smelting works for the French company at Kirkintilloch, in Scotland, I completed one furnace and was then instructed to put up other two. I actually erected five, and with twelve the company could not until the slackness of a few months ago overtake the work. The furnaces are small, and together they run about 4,500 tons per month. The ore is peculiar; it contains about eight per cent. of nickel and does not lend itself to treatment in large quantity. If it could be as easily fluxed as the Sudbury ore the furnaces could run through an enormous quantity. I think the supply of nickel is greater than the demand, and that this is the reason there is no greater expansion of the industry in this country or in New Caledonia. The demand is not by any means unlimited; we have got to make our trade as we go along."

Of course if there was an active and fast growing demand for nickel, miners and metallurgists would be found ready to supply it; and owing to the position of the mines in this Province and the great extent of the deposits, capitalists would easily be persuaded to invest money for mining and treating the ore if there was a sure prospect for unlimited sale of the product and of large profits being realized. There is no hindrance to investment in Ontario, and in the matter of large workable bodies of nickel ore this Province as far as yet known possesses a monopoly of it on this continent. There are drawbacks, but they are not insurmountable. As regards two or three of these I quote again from Mr. Cameron:

"The supply of nickel in the Sudbury district is unlimited, and there are a great many properties which have not been opened up. The New Celedonia ore, some of which occurs as a silicate and some as an oxide, averages as taken out of the mines from 5 to 6 per cent. of the nickel. I have got ore from there testing 25, 35 and 40 per cent. of nickel. This ore cannot be washed; it can only be cobbed or picked. The native laborers are set to cob it; they are good enough for that, and men, women and children may be employed at this work at a very low rate of wages. One trouble in this country is the dearness of labor, which costs as much as fifty per cent. of our whole expenditure. The duties up on stuff we buy also run up to a high percentage; for example, the duty on coke amounts to 8 or 10 cents per ton of ore. The net value of 3½ per cent. ore after paying all costs at present selling price cannot be more than $1 per ton, the royalty on which at 3 per cent. would be three cents per ton. The duty on coke therefore is three times as much as all that would be paid to the government for royalty."

As regards refining, Mr. Cameron says:

"I do not know that it would be a very great advantage to have the refining of nickel done in this country. According to present practices acids are required, and these cannot be bought as cheaply here as on the other side of the Atlantic, and there are other things we would have to import. Another disadvantage is that freight charges on refined nickel going to Europe would be greater than on matte. The rate on 100 tons of matte containing 50 per cent. of nickel would be $6 or $7 per ton; but owing to risk of carriage 50 tons of refined nickel would not be carried at $12 per ton. I do not think there is much hope of refining nickel in this country until the consumption here has greatly increased, or until chemicals and other necessaries of refining can be bought as cheaply as in England or France, or until a successful dry process has been introduced. We could not refine here according to present practices and under existing conditions and hope to sell the nickel in Europe, as there is a heavy duty on the fine metal in France and Germany as well as in the United States. There is of course none in Great Britain."

In the present state of the nickel industry there is no well founded cause for discouragement, except perhaps in the minds of extreme optimists with locations of unknown value on their hands to sell. Remembering that it is a comparatively new metal, and that until a few years ago its ore was scarce and hard to treat, the rank to which it has already attained is calculated to excite a feeling of wonder. The progress of operations in this Province in view of every circumstance, and especially of the fact that the largest refining concern in the world is also chief owner of the only mining properties which can compare in richness and extent with those of Ontario, has certainly been as active as the state of the market for the metal would seem to justify. Mining and smelting the ores had their beginning here less than seven years ago, yet measured by the number of men employed, the amount of wages paid for labor and the value of product last year, there are only six iron working industries of the Province, as shown by the census of 1881, which exceed this one; and among those are such old and stable industries as agricultural implements, blacksmithing, and foundry and machine shops. Of iron mines, there is not one that is worked, although we have iron ores in great abundance; neither is there one blast furnace to smelt iron ore, although we consume in the Province upwards of 300,000 tons of pig iron every year. All the indications point to a steady increase in the consumption of nickel; and the number and variety of new and valuable uses which are being found for it give assurance that the industry is firmly rooted and will grow.

A New Colliery Pick.—At the Derby Industrial Exhibition was exhibited a patent pick (Mitchell & Birkinshaw's) which has been brought out by the Union Pick and Tool Company. This pick consists of an ordinary shaft with a helve into which small blades or points are placed and renewed as occasion requires, each renewal being equal to an entireiy new pick of the ordinary type. A miner need carry only one shaft or head into the mine, but can take any number of small points, which may be carried without inconvenience.

The Choice of Coarse and Fine-Crushing Machinery and Processes of Ore Treatment.*

By A. G. Charleton.

Part II—The Relative Scope of Rival Methods of Ore Treatment.

Having examined the metallurgical nature of the various ores and processes (which have been superfically touched upon in the briefest possible manner), we are in a better position to proceed to the still more complicated and difficult questions of the relative prime cost of plant, working costs, and the percentage of gain or loss in rival methods of ore treatment. These are liable to differ in different countries, and under varying conditions even in the same neighborhood, according to the nature of the ore, cost and quality of labour, material and supplies, as well as the economical or uneconomical manipulative or mechanical modifications in treatment, which can be introduced in each case, on which probably more than anything else, the individual economy or wastefulness (the profit and loss in fact) in works of the same class will depend.

To form an estimate of the prime cost of plant, we must either know the ordinary gross cost of a mill of a certain size and description in any particular locality, or, what is better, the actual quantities and prices of material of different kinds used, and the number of shifts worked by different classes of artizans at specific wages rates, in the construction of the foundations and superstructure of the building, and the erection of the machinery; as well as the price of the machinery itself, the weight of all the transportable material, and freight rates.

The collection of such facts is unfortunately too rare in mining operations to make it always an easy matter to form estimates of the kind applicable to different localities. It is only by piecing together fragments of information obtainable here and there that one can get anywhere near the truth.

Under the category of rival processes, the relative costs and results of treating the following classes of ore may be compared:—

1. Pyritic gold ore by chlorination in vats and chlorination in barrels, and by the new cyanide process, as well as by grinding (without roasting) in pans and arrastras.
2. Silver ores in general,† by wet and dry crushing and pan-amalgamation, the patio and other processes, as compared with the ordinary and Russel lixiviation processes.
3. Free-gold ores by battery-amalgamation, both with and without grinding, and concentration.

The cost and loss in coarse-concentration and smelting have already been considered, and will not be referred to again.

There is no branch of ore treatment which admits of wider differences of internal detail than wet concentration (producing a corresponding effect on its cost‡), but such points cannot possibly be entered into here; and as regards dry concentration, it cannot at present seriously be regarded as a rival to wet methods, and may therefore be passed over entirely.

The concentration of sulphide ores of gold and silver often depends on the relative proportion the sulphides bear to the gangue. No sharp line of distinction can be drawn between ores which are suitable for concentration or not, as average value local cost of treatment enter into the calculation, but roughly speaking, such ores as contain 40 per cent. of sulphides are not usually suitable for concentration. Frequently an ore which will average 20 to 50 per cent. of sulphides, coming from the mine, is best divided by hand selection into first-class ore (to be treated by smelting, or some other process), and a second and poorer class for concentration.

In a mine where the ore runs in seams and pockets of solid mineral, it may happen that 100 tons of crude ore will contain on an average 20 per cent. of sulphides, which can be separated by hand selection into 20 tons of 75 per cent. sulphides and 80 tons of 6¼ per cent. sulphides. When this can be done cheaply it is often better than subjecting the whole 100 tons to the costs and losses of concentration, whilst it renders commercially possible a more expensive but more efficient process than the original ore could bear.

A point to be remembered, however, in concentration is, that clean, that is to say pure concentrates, are often as important to obtain as clean tailings (which latter are essential for close saving). You may have the one without the other, and although a clean separation of the metallic components of the ore is almost always advisable, in some instances it may be desirable to leave a certain proportion of sand or gangue in the headings, either as a flux for smelting (as previously pointed out) or to lighten the pan-charges in amalgamation.

* *Trans. Fed. Inst.*, vol. iv., page 233.

† The term is applied to ores which do not contain more than, say 10 to 15 per cent. lead. Ores with more than 15 per cent. of lead are known as silver-lead ores, and are smelted when circumstances admit of it, which is the only admissible proposition for their treatment. Carbonate of lead and galena are converted by roasting sometimes into oxy-chloride and sometimes into sulphate; the former goes into the amalgam, whilst the latter does not amalgamate, and this circumstance explains why some bullion of plumbiferous silver ores is free from lead, whilst other bullion sometimes contains 600 parts of lead in 1,000, according to the condition of the lead in the roasted ore.

† In western mining camps, the cost generally runs between 4s. 2d. and 12s. 6d.

Vat and Barrel-chlorination.

For working a few tons of concentrates per day the regular Plattner process, with fixed tanks and long exposure to gas, is as convenient and economical as any of the improved processes, because the plant is simple and cheap to erect, and very few hands are required to run it.*

The production of gas is a simple question of relative costs of different chemicals delivered at the mine. For working large quantities of ore daily, especially if of comparatively low grade, which requires economy in crushing, roasting, gas consumption, labour, and time, the use of barrels, in place of fixed tanks, effects a saving in time and labour, and makes special watchful skill less important in the whole process than in the Plattner method, so that one of the modifications of the barrel system would be naturally adopted on crude ore and in dealing with large quantities of concentrates.

The attrition of the ore particles and the thorough turning over of the charge in the presence of nascent chlorine in the barrels, has also some effect upon the results, especially if there be coarse-gold present which has to be amalgamated afterwards, as the gold, it is said, is attacked with much greater avidity by the mercury in consequence of the clean surface created by the action of the chlorine and attrition combined. It is necessary, however, that the tailings should first be washed, by continuing the leaching, till all trace of chlorine has disappeared, and that they should be treated by amalgamation at once. If left to dry, the gold particles assume a red colour and amalgamate with great difficulty.

The most successful furnaces in general use for chlorination-roasting appear to be of three types:—

1. Plain or step-hearth reverberatories furnaces, of the Fortschaufelung class, with a hearth surface of about 12 feet wide by 75 feet long.
2. Horizontal round-hearthed mechanical furnaces, of the English Brunton-calciner type, about 12 feet diameter.
3. A modified form of the Spence furnace.

To which may perhaps be added an altogether new modification of the Fortschaufelung furnace, which will be alluded to later on.

When battery-amalgamation and concentration precedes chlorination, Mr. A. Thies† recommends the use of brass-wire screens in place of slot punched sheet-iron ones, stating that when using 36-mesh brass-wire in place of 40-mesh slotted iron, at Haile, in North Carolina, he obtained a far more uniform pulp for concentration, whilst the average life of the wire was found to be six weeks as compared with the sheets, which had to be thrown out in fourteen days, a matter which is worth noting. German practice certainly supports this view so far as concerns the effect of wire screens on the concentration results.

Dr. Egleston states that the correct amount of charge, in roasting gold-sulphides in the reverberatory furnace, is usually 10 to 12 lbs. per square foot of hearth; an ordinary charge amounting to about a ton at a time on each division of the earth, of which there are usually three.

A furnace of this description, designed to handle from 3 to 4½ tons of concentrates per 24 hours, 75 feet long by 11 feet wide inside, requiries for its construction 40,000 common bricks, 8,000 fire bricks, and 5 barrels of fire-clay, and the iron work, tie-bars, etc., exclusive of T-rails, weighs 11,000 lbs. A furnace with a 14 feet by 60 feet hearth requiries 86,000 red bricks and 15,000 firebricks, and cost about £626 in Pueblo or Denver.

In vat-chlorination, the rest of the plant to correspond, covered in (as the furnace must also be), consists of a drier, a set of fixed or rotating leaching-vats, with (in some cases) silver-leaching tubs added, precipitating-tanks, and reagent tanks, well and pump, lead-generator, heating-pan and wash-bottle, a drying muffle and melting furnace, and a press and filters for precipitate, as well as filter-tubs for the base metals‡ in the waste-solutions, and cars for handling the ore, overhead tackle for lifting the vat-covers and tools, etc.

The cost of a plant of the kind in California, with a capacity of 6 tons in 24 hours, is stated§ to vary between 6,000 and 7,000 dols. (£1,250 to £1,458 6s. 8d.). A small plant would cost about half the former sum.

The Thies modification‖ of the Mears processs (one of the most successful unpatented systems of barrel-treatment), requiries the substitution of rotating barrels for vats, the chlorine being generated inside the barrels, by the action of sulphuric acid (66 degs. B.) on bleaching powder, which is added to the charge of water and ore under ordinary circumstances in the proportion of 10 to 30 lbs. of chloride of lime to about 15 to 30 lbs. of acid per ton of charge of roasted ore in each barrel.

If copper is present more of these reagents are required.

The barrels must be run by steam or water-power, the latter being, of course, the most economical, when available.

The rest of the plant, though differently arranged, is substantially the same as that for vat-chlorination, and will cost not less than £620 for works with a capacity of 5 tons per day; the weight of the machinery will be about 17 tons.

* *Gold Amalgamation and Concentration*, page 28.

† "The Thies Process of Treating Low-grade Auriferous Sulphides."—*Trans. Am. Inst. Min. Eng.*, vol. xix., page 601.

‡ If present and worth the extra treatment.

§ "The Milling of Gold Ores in California," by John Hays Hammond. *Eighth Annual Report of the California State Mineralogist*, page 696.

‖ A description of this process is given by Dr. Egleston in *The Metallurgy of Gold and Mercury*, page 664, *et seq.*

The cost of the vat process at the works of the Plymouth Consolidated Company,* where 100 tons of concentrates is treated per month of thirty days (leaching taking twenty-four days), is given as follows:—

Roasting—	£ s. d.	£ s. d.
3 men at 10s. 5d. per day for 30 days	46 17 6	
1¾ cords of wood at 17s. 8½d.	46 9 8½	
54 lbs. of salt at 3s. 8d.	2 10 7½	
		95 17 10
Chlorine (employing two generators)—		
60 lbs. of manganese per day at £9 15s. 10d. per ton	7 1 0	
68 lbs. of salt per day at £3 2s. 6d. per ton	2 11 0	
120 lbs. of acid per day at £12 10s. 0d. per ton	18 0 0	
		27 12 0
Leaching—		
40 lbs. of sulphuric acid for settling-tanks for 24 days	6 0 0	
40 lbs. of sulphuric acid for making sulphate of iron for 24 days	6 0 0	
Wages of leachers (2 men at £1 2s. 11d.†) for 30 days	34 7 6	
Wages of foreman	26 0 10	
		72 8 4
Total cost per month		£195 18 2

or £1 19s 2d. per ton.‡

At the Providence Works‖ two furnaces are used, which have a capacity of 9 tons in 24 hours. Each furnace consumes 1 cord of wood, and the cost per day can be reckoned as shown in detail on page 366. This makes the cost of treatment per ton of sulphides to be 14s. 9½d. when the works are run at full capacity.

As the ore, however, only contains about 7 per cent. of sulphides, or 4⅓ tons in the 62 tons milled daily, this quantity does not keep the two furnaces running full time, though both of them are in constant operation. As most of the expenses remain the same, whether running at full capacity or not, the actual cost of chlorination, figured on a working basis of 4½ tons treated daily, approximates, therefore, more nearly to £5 13s. 10d. per day, or £1 5s. 3½d. per ton of concentrates, as detailed below. Add to the above sum (£5 13s. 10d.) the cost of milling per day, viz., £11 19s. 7d., and it will be found to represent a total outlay of £17 13s. 5d. per day, or a total charge of 5s. 8½d.¶ per ton of crude ore raised from the mine.

This estimate makes no allowance for general supervision, interest on first cost, or deterioration. The conditions of treatment in these works are, however, very special, and can hardly be considered as a basis to estimate upon in most instances.

The estimated cost of the treament of 4½ tons per day is:—

	£ s. d.
Labour	2 13 1½
2 cords of wood at £1 0s. 10d.	2 1 8
14 lbs. of manganese at 1⅜d.	0 1 7
126 lbs. of salt at ½d.	0 5 3
104 lbs. of acid at 1d.	0 8 8
Lime, sulphur, and calcium hyposulphite	0 0 7½
Illuminating	0 0 10
Extras	0 2 1
Total cost per day	£5 13 10

or £1 5s. 3½d. per ton.

At the Alaska Treadwell Company's works the cost for the year ending May 31st, 1891, was as follows, calculated on a basis of 3,568 tons of concentrates treated:—

Labour.

	Cost per Ton. (American money) Dollars	(English money) £ s. d.	Gross cost Dollars	Gross cost £ s. d.
Foremen	·5600	..	3,006·43	..
Engineers and. Foremen	·0534	..	286·38	..
Gas generator	·2089	..	1,121·29	..
Salters	·0855	..	458·24	..
Floormen	·7604	..	4,080·83	..
Roasters	2·9400	..	15,782·49	..
Carmen	·2077	..	1,114·72	..
Carpenters	·0039	..	21·39	..
Labourers (white)	·0999	..	536·62	..
" (Indian)	·0309	..	166·00	..
Teamster	·0806	..	433·11	..
	$5·0312	£1 0 11½	$27,007·50	£5,626 11 3

* *Trans. Am. Inst. Min. Eng.*, vol. xv., page 305.

† Two men on day shift attend to all the work of handling the ore after it is leached. The head man receives 12s. 6d., the others 10s. 5d. Only three tankfuls are leached every four days; but the men are employed steadily. The sulphate of iron is manufactured on the spot.

‡ To this should be added for assays, repairs, supplies, insurance, taxes, water, interest on invested capital, and deterioration of plant, as well as proportion of general expenses and superintendence, about 16s. 8d. additional per ton, making the total cost of working £2 15s. 10d. per ton.—*Eighth Annual Report of the California State Mineralogist*, page 48.

‖ *School of Mines Quarterly*, vol. v., and Egleston's *Gold*, page 657.

¶ 1s. 10½d. of this is chargeable to the chlorination.

Supplies.						
Acid	1·0220	..	5,486·38	..		
Wood	1·5230	..	8,175·93	..		
Coal	·0543	..	284·80	..		
Furnace supplies	·0270	..	145·19	..		
Manganese and salt	·8095	..	4,345·86	..		
Pipe	·0089	..	47·90	..		
Generator fittings	·0038	..	25·93	..		
Leaching tanks	·0638	..	339·05	..		
Miscellaneous	·1353	..	727·26	..		
Rake-heads	·0360	..	193·50	..		
Car wheels	·0037	..	27·50	..		
Repair account	·1352	.	720·08	..		
Electric light acct.	·1077	..	578·49	..		
Haulage account	·0549	..	294·77	..		
	$3.9852	£0 16 7¼	$21,392·63	£4,456 15 11½		
Total cost per ton of sulphides	$9·0164*	£1 17 6¾	$48,400·13	£10,083 7 2½		

	Cents.		s.	d.
Mining	65	=	2	8½
Milling and concentrating	33	=	1	4½
Chlorination	19	=	0	9½
General expenses (mine)	8	=	0	4
General expenses (in San Francisco)	2	=	0	1
Bullion freight, etc.	5	=	0	2½
	$1.32	=	5	6

per crude ton of ore, but the average for some time previous was 6s. 3d. per ton.

The roasting at these works is done in Spence automatic furnaces, each with four hearths, which roast 8 tons per day. On the hearth next the lower one, 3 per cent. of salt is added with a special spoon. The ore, instead of being as formerly stirred by fixed rakes, is now rabbled by oscillating ones, which tip every three minutes. On the upper drying-hearth they last a long time, but on the lower ones, where the heat must be great to drive off the last traces of sulphur, their life is only about three months.

Formerly the rakes stopped between the forward and backward motion just over the flue, now they are made to go beyond it, and are no longer exposed, as they were at this point, to the sulphurous gases and hot falling ore, which clogged the end of the shelves and gave such trouble at the Haile mine, finally causing the abandonment of the Spence furnaee there for roasting fine ores, although admittedly a most excellent meehanical roaster for coarser grades of material in its original shape.

With the important modifications above alluded to it seems doubtful (judged by the above facts) how far Mr. Thies' condemnation of the Spence furnace † (in works wtth a capacity of 3 to 4 tons) for fine ores (where a dead sweet roast is required) is entirely justified.

The labour involved in vat-chlorination on an average may be taken at :—

1 man, who works 10 hours, to bring in wood and ore.
1 man at the furnace, who works 8 hours.
1 chlorinator, " 8 "
3 labourers (1 on shift by day, and 2 by night).

At Sutton Creek it takes 8 men for the whole 24 hours, one ehlorinator, one helper, five men at the furnace, and one who wheels ore.

The consumption of chemicals per ton of ore is about as follows :—

Salt in the furnaee	40 lbs.
" " generator	6 "
Manganese	6 "
Sulphurie acid generator (66 degs. B.)	20 "

The stock of chemieals ordinarily kept on hand, on the scale of operations of the Alaska Treadwell Company, seems to be :—

	£ s. d.	£ s. d.
Salt, about 53 tons, valued at	2 17 11 ..	153 9 7
Manganese, 13 "	9 15 10 ..	127 5 10
Sulphuric acid, 35 tanks at	8 18 10½ ..	313 0 7½
Total value		£593 16 0½

The works in Grass Valley, where vat-chlorination is most extensively used, guarantee an extraction of 90 per cent. of the gold, and 60 per cent. of the silver, but the saving more often amounts to between 90 and 94 per eent. of the gold in pyritic-concentrates, and over 60 per cent. of the silver, if the tailings are leached to obtain it.

The ore to be properly roasted ready for leaching should maintain a nearly vertical face when made into heaps on the finishing hearth, and cut down with a spadelle. It should show no bright specks, but be inclined to become black, which will generally be in 7 or 8 hours. The largest amount of gold has been shown to be in the best condition to be leached and to consume the the least amount of chlorine in chlorinating it, when the ore falling in the furnaee, in turning it over, has a slight violet colour. When the ore sparkles, and the sparks are numerous and bright, it shows that the roasting is not properly finished, and more salt has to be used.*

A ton of roasted ore will occupy usually 24½ cubic feet. This quantity is derived from 2,800 lbs. of raw sulphides, which occupy about 13⅔ cubie feet per ton (2,000 lbs.). A ton of sulphides will weigh from 1,450 to 1,700 lbs. after roasting, and occupy about 17½ cubic feet. The roasted ore ought not to eontain more than 1⅜ per cent. of sulphur.*

At the Plymouth Consolidated works, the Fortsehaufelungs-ofen used for roasting is 12 feet wide by 80 feet long, including the fire-box, the hearth being a continuous plane, but the charges, of whieh there are three in the furnace at one time, are kept entirely separate. They are ealled by the furnacemen the drying, burning, and cooking compartments. In the middle division the ore is spread out very thin, and oeeupies about double the space of either of the others.

The furnaee is worked by 8 hours' shifts, a charge being drawn and added in each shift. The eharges weigh 2,400 lbs. and carry about 10 per cent. moisture.

The ore averages about 20 per cent. of sulphur, and just before the sulphur ceases flaming in the second division of the furnace 18 lbs. or ¾ per cent. of salt is added to the charge. Care must be taken to keep conecntrates damp until they are reduced into the furnace, or a decomposition of the pyrites begins, forming lumps which do not roast, and consequently cause a loss of gold in the residues from leaching. The roasted ore from eaeh shift is kept by itself on the cooling floor until a tankful (about 4 tons) has accumulated from a single man's shift, and it is then worked by itself. This enables the foreman to better eontrol the work of roasting, for if one lot out of three works badly, it points to the fault being with the furnaceman; whereas, if all three give unsatisfactory results, it may be presumed to be owing to a change in the ore, and the roasting must be modified.

The vats † for chloridizing the roasted ore are 9 feet in diameter by 3 feet in height; they are four in number, and are slightly inclined forward to drain them completely. The bottom of each tank is composed of a filter about 6 inches thick, eonsisting of light strips of ¾ ineh wood laid on the bottom at intervals of about a foot. Across these are placed 6 inch boards, spaced an ineh apart. On this loose floor coarse lumps of quartz are spread, and on the top of this again quartz-sand, until a depth of 6 inehes is obtained. Finally, this sand filter is covered over with another loose floor, the boards lying cross-wise to the loose floor beneath and pretty close together. This upper floor is merely to facilitate shovelling the charge out when it has been gassed to permit the removal of the leached ore without disturbing the filter.

The ore to be ehloridized must be damp (about 6 per cent. moisture). The working test is to take a handful of ore and squeeze it, then open the hand, and if the lump immediately begins to erumble and fall apart (not run) the ore has the requisite amount of moisture. The damp ore is screened into the tank so as to lie as loose as possible and thus facilitate the penetration of the ehlorine. A coarse screen of one-and-a-half mesh is used for this purpose.

The tanks are only filled up to within about 3 inches of the top, (to ensure the entire contents being eovered with water in the subsequent leaching,) otherwise there would be great difficulty in washing out the soluble gold. As soon as they are full they are gassed. The gas is introduced into the bottom from two opposite sides, and is eontinued until ammonia held over the ore gives off dense flumes of ammonium chloride, which usually happens in about 4 hours. When this point is reached, covers are plaeed on the tanks and luted on.‡

The two gas-generators § which are employed to charge a tank are allowed to work on till nearly exhausted, when they are diseonnected, and the holes in tank are plugged up. The tanks are usually charged in the morning, and left standing two days. On the third day the ore is leached. The tank is first filled with water, and allowed to stand a few minutes to permit the water to penetrate the ore. If no more water is absorbed, the liquor is drawn off at the bottom, care being taken to keep the tank full of water during this part of the operation, which lasts 4 to 5 hours.

For charging the tank a gunny sack is laid on the ore and held down with a couple of bricks where the wash-water is afterwards to be introduced, in order to better distribute the water in the tank, and prevent it washing out holes and paeking the ore.

The liquor from the leaching-vats is conducted to settling or storage-tanks, where about 40 lbs. of sulphuric acid is added (66 degrees B.) and it is allowed to stand 2 to 24 hours. It is then run into the precipitating-vats, where the gold is precipitated with sulphate of iron; the iron solution being added until after stirring, a further addition produces no purple colour. After the gold is preeipitated it is allowed to stand from two to three days to settle, when the supernatant liquor is drawn off with syphons into a second settling-tank, where any gold drawn off by the syphons has a second opportunity of settling.

The liquor stands in this tank until it is necessary to run it off to make room for a fresh eharge. Very little gold is found in this tank, so it is only cleaned out about once a year.

In the meantime fresh liquor has been run into the precipitating-tanks on the gold already precipitated there. In this way the gold is accumulated till the semi-monthly elean up, the precipitating-tanks being kept loeked and covered. In making a clean-up, the supernatant liquor is syphoned off, the gold gathered up, and placed in a filter of punched iron, lined with filter-paper, and washed with water till all the acid and iron salts are removed. It is then dried, melted in crucibles, and cast into bars.

Under unfavourable conditions the cost of the chlorination process may run up as high as £4 3s. 4d. per ton, but in California it may generally be taken as costing £1 17s. 6d. to £3 1s. 6d, per ton, £2 14s. 2d. being in all probability a fair average on a basis of treating 3 tons or more daily.

Mr. G. F. Deetken is responsible for the statement * that with favourable conditions of cheap wood and freight rates, not counting interest, insurance and amortization of a eapital of 3,000 dollars, the working expenses in some parts of California do not exceed £1 0s. 10d., and are sometimes as low as 16s. 8d. per ton.

In locating works of this kind it is important to secure a good fall, and they should be terraced and so placed with reference to the prevailing winds that noxious fumes will not be earried in the direetion of valuable land or house property.

There should also be a supply of water at hand, delivering 40 to 60 gallons per hour.

Barrel-chlorination.

Mr. Thies, in a letter to Mr. C. N. Aaron (a well-known Californian authority), gives the cost of the Thies proeess at the Haile mine, North California, as follows :—

Using a double reverberatory furnace, which furnishes 2 tons of roasted ore every 24 hours, with an average consumption of 1 eord of wood, at 5s. 2½d. per eord, and employing four labourers, the cost of roasting the ore amounts to 10s. 11¼d. per ton. Two men ean easily treat 4 tons in 10 hours, elevate the ore, and clean out the filter-tanks, of which there are four to each barrel. Arranged on this basis, the cost of roasting and chlorinating amounts to 19s. 3¼d. per ton, as tabulated below :—

	Cost per Ton. s.	d.
Roasting 2 tons of ore—		
4 labourers at 4s. 2d.	8 4	
1 cord of wood at 5s. 2½d.	2 7¼	
	10	11¼
Chlorinating 4 tons of ore—		
2 labourers at 3s. 9d.	1 10½	
1 ehlorinator at 8s. 4d.	2 1	
40 lbs. of bleaching powder at 1½d.	1 3	
60 lbs sulphurie acid at 1d.	1 3	
Sulphuric acid, for making ferrous sulphate	0 6¼	
Repairs, wear and tear.	0 10	
Power	0 6¼	
	8	4
Total eost per ton	19s.	3¼

We thus have the sum of 19s. 3¼d. for roasting and chlorinating 1 ton of roasted ore, representing 1⅓ tons of raw iron pyrites.

Inside of 7 hours from the time the ore is in the chlorinator, the solutions are ready for precipitation and the tailings are clean.

At the Phœnix mine, in North Carolina, the cost for roasting † and chlorinating by the Thies proeess is estimated at :—‡

	£ s. d.
Roasting	0 9 1
Chlorinating	0 11 2
	£1 0 2

2,353 tons of concentrates are said to have been successfully treated by this process at the Haile mine and 5,000 tons at the Phœnix mine between May, 1888, and September, 1890.

At the Phœnix mine, a 12 feet revolving pan-furnace is used, which roasts 1 ton of raw ore in 12 hours, with a consumption of ⅜ths of a cord of wood, and 3s. 9d. worth of labour. The cost of power does not exceed 1s. 0½d. per ton.

At the Bunker Hill works, the coneentrates are roasted with 1 per cent. of salt, in a reverberatory furnace 40 feet by 12 feet on the outside, with walls 18 inches thick, the stationary hearth of which (7 feet by 18 feet by 2 feet in height, with a working door on each side) terminates in a horizontal revolving hearth, 12 feet in diameter, set at a lower level (giving a fall of 6 or 7 feet). The discharge hole or cub is in the eentre of this latter hearth, from which the ore drops into ears.

At the Deloro mine, § Canada, where the Mears process was formerly in operation, the ore was roasted (after drying in a revolving drier) in a pair of cylinders, one

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* In the six months ending November 31st, 1892, this charge was reduced to $8·42 = £1 15s. 1d. per ton of sulphides. As an instance of economical management, the total costs of mining and milling per crude ton extracted may be cited as follows, the ore being quarried in open benches :—

† *Trans. Am. Inst. Min. Eng.*, vol. xix., page 610.

* The heat on the finishing hearth must be maintained at a lively bright red, but not at a white heat, else the gold particles would melt, which, with a good magnifying glass, can be easily detected; after washing off the iron the gold appears then in minute globules, the chlorniation of which is more difficult.

* Egleston, *Gold*, page 622.

† The vats should be coated on the inside with asphaltum varnish or a mixture of pitch and tar applied hot, but the former is preferable, as it penetrates better into the pores of the wood.

‡ It is usual to provide the covers of the tanks with two pieces of 1¼ inches gas pipe 6 inches long, and a square hole, 6 inches by 6 inches, closed with a wooden cover. These pipes are closed with balls of clay during the impregnation of the ore with gas. After gassing, the clay is removed, and one of the pipes is coupled to the hose of the water tank, whilst the other is connected either with another tank ready for chloridizing, or the ashpit of the roasting furnace, partly to utilize the surplus chlorine, as well as to protect the workingmen from its injurious effects

* When practicable, it is a good plan to heat the generators by steam in place of direct heat.

* *Eng. and Min. Jour.*, New York, vol. lv., page 244.

† Removing the sulphur to within 0·25 per cent.

‡ Phillips, *Trans. Am. Inst. Min. Eng.*, vol. xvii., page 321.

§ R. P. Rothwell, *Trans. Am. Inst. Min. Eng.*, vol. xi., page 191.

‖ Different furnaces require, on the average, it is said, the following weights of wood to roast a ton of ore (the weight being calculated on the basis of 2,200 lbs. per cord as an average):—White furnace, 300 lbs.; Bruckner, 900 lbs.; reverberatory, 600 lbs.; Stetefeldt, 200 lbs.—(Report, *Tenth Census, United States.*)

30 feet in length by 5 feet in diameter, the other 20 feet by 4 feet, set tandem, jacked with mineral wool and then paper. It is claimed that 10 tons of concentrates have been roasted in these cylinders in 24 hours, so that extraction of gold has reached 93 to 98 per cent.

The tanks used in the process should be built of wood which has been soaked in linseed oil, dried, and painted with three good coats of white lead or tar.

Mr. Thies states that the cost of barrel-treatment depends chiefly on the number of tons chlorinated per day.

The wear on the inner lead-linings of the chlorinators is imperceptible; a chlorinator in use at the Phœnix mine for over five years does not show any wear. The lining is fastened on with bolts from the outside, as it has been found very difficult to burn on lead, when chlorine has acted on it, in making repairs.

At the Haile mine, the fire-assay and value of the ore delivered to the stamps is 4·50 dollars (18s. 9d.) per ton.

The mint returns of bullion have 16s. 3d. per ton of ore treated, of which 6s. 0½d. is to be credited to the battery, *i. e.*, to free-gold; whilst 10s. 2½d. was obtained from the sulphides.

Taking the assay-value of the ore at 18s. 9d., and the actual yield in bullion at 16s. 3d., there is an indicated loss of 2s. 6d. per ton, or 13⅓ per cent. Taking the yield in free-gold at 6s. 0½d. per ton from an ore worth 18s. 9d. per ton (or approximately 32 per cent. of the gross value by assay), we have 68 per cent. to be debited to the concentrates. But the total yield in free-gold, and in gold from the sulphides being 16s. 3d., the ratio of the free-gold saved, to the total amount saved, is approximately 38 per cent., and the combined gold 62 per cent., or a saving of about one-third free and two-thirds combined gold.

The term, combined gold, has been used to express the condition of the gold which is not free. Whether the gold that is not free is chemically or mechanically diffused in the sulphides or both is uncertain, in most cases.

Mr. T. W. T. Atherton * claims to have found gold as a natural sulphide in the pyrites of the Deep Creek mines of New South Wales. He gives an analysis of the ore and the method pursued in experimenting on it, from which his conclusions were drawn.

From 80 tons of ore stamped per day of 24 hours at Haile, 7½ tons of concentrates are obtained from 16 Embrey end-shake tables, which gives as the yield of each concentrator a little less than half a ton.

The average assay-value of the raw concentrates for the 12 months preceding the date of Mr. Thies' paper was £6 5s. per ton, and the percentage of sulphur they contained varied between 40 and 45 per cent. In roasting, this was brought down to 0·25 to 0·40 per cent., whilst the value of the material naturally increased; the raw concentrates worth £6 5s. becoming worth when roasted £8 6s. 8d., or about one-third more per ton.

The assay-value of the tailings thrown away, after chlorinating the roasted ore, was, on the average, only 8s. 4d. per ton, representing an extraction of 95 per cent.

The process had been in successful operation 2½ years, at Haile, when Mr. Thies' paper was written in 1890, and 36,000 tons of crude ore had been treated profitably during that time, prior to which nearly every process had been tried on the ore and failed.

The advantages of the process are:—The small amount of space the plant occupies, speed of operation, high percentage of yield, facility of ascertaining the condition of the charge at any time, † and very slight wear and tear. The only offsets against these advantages are the care and intelligence required to control it, and the need for a small amount of power.

250 to 300 gallons of wash-water are needed per ton of ore treated (an ordinary charge), the water being introduced into the barrel first.

It takes 2 to 4 hours to chlorinate each charge, the barrel revolving at 12 revolutions per minute.

The lead-lining is ¼ inch thick, and weighs 12 lbs. per square foot.

The filters must be flooded from below with 4 or 5 inches of water to prevent the ore packing as it falls into them.

The charge must be allowed to drain, and then washed with water as rapidly as possible till the wash-water show no gold, though still carrying traces of chlorine.

If lime is present, settling-tanks, called stock tanks, are required to settle the liquors which are drawn out of them into the precipitating tanks after standing for 14 to 16 hours.

The precipitating-tanks are large enough to hold the liquors from 3 tons of washed ore. The ferrous sulphate is syphoned into them. The solution must have a decidedly acid re-action in order to be certain that all the lime has been converted into sulphate.

The Providence works and those of Bunker's Hill may be cited, the former as showing exceptionally low cost by the vat process, working 9 tons per diem; the latter usually high cost by barrel-treatment, treating 2 tons in 24 hours. To compensate for this the loss in the tailings, which used to run as high as £1 9s. 2d. when worked by the ordinary vat process, has been reduced 50 per cent.

The cost at the Providence works:—

	£	s.	d.
1 foreman	0	12	6
1 white labourer	0	9	4½
5 Chinamen at 6s. 3d.	1	11	3
2 cords of wood at £1 0s. 10d.	2	1	8
29 lbs. of dioxide of manganese at 1⅜d.	0	3	4
260 lbs. of salt at ½d.	0	10	10
216 lbs. of sulphuric acid at 1d.	0	18	0
Lime, sulphur, and calcium hyposulphite	0	1	3
Illuminating	0	0	10
Extras	0	4	2
	£6	13	2½

Per ton.....14s. 9½d.

The cost at the Bunker Hill works:—

Roasting—	s.	d.	£	s.	d.
2 roasters at 13s. 6½d.	13	6½			
⅝ths cords of wood at £1 5s.	15	7½			
			1	9	2
Chlorinating—					
1 chlorinator at 12s. 6d.	6	3			
30 lbs. of bleaching paper at 2d.	5	0			
36 lbs. of salt at ⅜d.	0	7½			
20 lbs. sulphuric acid, 66 B. at 1¾d	5	3			
Water-power	2	1			
General expenses and loss	12	6			
			1	11	8½
Total cost of 1 ton of ore roasted and chlorinated			£3	0	10½

Under efficient management and favourable conditions the cost of barrel chlorination will usually be found to vary between 12s. 6d. and £1 0s. 10d. per ton in America.

The results of treatment by another vat-process, the Pollock patent, are given in the *London Mining Journal*,* treating various ores as follows:—

	Ozs.	Dwts.	Grs.	Percentage Extracted.
Sheba mine tailings	2	7	21	96
Mixed lot of ore, Transvaal	1	3	22	97
Day Dawn P.C. quartz, Q. 6.	6	9	23	97
" concentrates, Q 1	1	2	6	97
Swaziland quartz, South Africa	0	16	5	95
City and Suburban quartz, Transvaal	12	10	10	95
Crown ore, New Zealand	3	16	0	94
Transvaal Gold Extracting Co.	1	10	11	93
" " tailings	0	7	8	85
Mount Shamrock tailings	0	8	17	96

It is stated that the cost of the plant for treating 100 tons a day is about £10,000.

It is certain that ores like those of Meadow Lake district, California, composed of a species of siliceous hæmatite (which in depth will probably be found in an unoxidized condition, consisting mainly of pyrite) will not amalgamate properly, and attempts have been made with various devices and countless processes to work them, but so far without success.

They are said to average £1 9s. 2d. to £2 1s. 8d. per ton or over, and to bear a resemblance to the ores of Bald Mountain district, South Dakota. It is possible that if a sufficient quantity of concentrates could be secured to keep works of the kind running many of these ores could be advantageously handled by the barrel-chlorination process, without a previous roasting, if treated with an oxidizing agent such as nitre cake, and in working the surface-ores even concentration might at first be dispensed with.

An interesting modification of the barrel process (described by John E. Rothwell, *Eleventh Census*, United States, 1890) is to make the chlorination barrel also the washing and leaching-vessel. This is effected by fixing a diaphragm as a filtering medium, so as to form the chord of an arc of the interior of the barrel. The diaphragm or filter is made up of plates corrugated similarly to the ordinary filter-press plate, and perforated with holes every 4 or 6 inches square. These plates are supported on bearings bolted to the shell. On the top of the corrugated plates is placed the filtering medium—an open-woven asbestos cloth. It is about as coarse as the common gunny-sack, but the warp and woof are of much heavier thread.

Over this is placed an open grating, and the whole is held in place by cross-pieces, the ends of which rest under straps bolted to the inside shell. In this way, though the whole is rigidly held in place, it is very easily and quickly removed when necessary to change the asbestos cloth. Two valves on each end of the barrel above and below the filter, are provided for the inlet and outlet of the wash-water and solution respectively.

The barrel is charged by first filling the space under the filter with water, which at the same time is allowed to pass through the filteriug medium and wash it, then the required quantity of water is put in above the filter. There are two methods of charging the pulp, lime-chloride, and sulphuric acid. In one the lime is so placed in the ore-charge in the hopper over the barrel that it goes in with the ore and is completely buried with it. The acid can then be added with very little danger of generating any gas before the plate on the charging-hole can be put on and securely fastened. The other way, which seems still better, is to pour the acid first into the water, through which it sinks to the bottom in a mass, and does not mix. The ore is then let in, and the lime added last. The chances of generating any gas are stated in this way to be much less. A barrel so charged has been known to remain open 5 to 10 minutes after charging without generating gas, but it has been demonstrated that on the first revolution of the barrel the gas is at once liberated and creates considerable pressure. After the chlorination is complete the barrel is stopped, so that the filter assumes an horizontal position. The hose is attached to one of the outlet pipes, and conducts the solution to the reservoir tanks. A hose is also attached to the inlet pipe, water is pumped in under pressure, and the leaching commences.

The air in the top part of the barrel is compressed, and forms an elastic cushion, which gives the wash-water perfect freedom to circulate over the whole surface of the charge, and wash every portion thoroughly with the smallest quantity of water possible. By washing in this way no gas is allowed to escape into the building. The solution runs into a covered reservoir-tank from which an exhaust fan draws the excess of gas, and discharges it outside the building. The length of time needed to do the leaching, varies with the leaching-quality of the ore. Charges having been leached in 40 minutes with a pressure of 30 to 40 lbs. per square inch. With higher pressures the time can be materially shortened. As can be readily seen, the ore in the barrel is in the best possible shape for rapid and perfect bleaching. When the barrel is stopped the ore settles on the filter, the coarsest and heaviest on the bottom, graduated evenly over the whole surface up through the charge to the slimes on top. In order to facilitate the leaching of charges carrying an excess of dust, a valve placed in the casing of the head (on a level with the surface of the pulp) is opened just after the barrel is stopped, and the slime remaining in suspension is run off into an outside washing filter-press, where it it can be treated separately, and the charge washed in the usual way. The tailings are discharged into a car which will hold the whole charge of ore and water and then run out, or if water is abundant they are discharged into a sluice and washed away.

For leaching purposes the amount of water needed to wash a charge varies very little with the richness of the ore, going to show the perfect leaching-condition of the ore in the barrel. The amount required is about 120 gallons per ton more than the quantity used in the barrel for chlorination, which is about 100 gallons per ton.

In order to get a concentrated solution for after-treatment, and to reduce the amount of solution to be treated, a tank is placed over the barrel, and when the richest of the solution and wash-water has run out into the reservoir-tank the discharge hose is connected with a pipe leading to the upper tank, and the washing is finished into it. The solution collected in this way is used in the next following charge in the barrel. The quantity of solution to be precipitated is thus reduced to 120 gallons per ton of ore treated.

The advantages claimed for this method are: (1) the freedom of the building from chlorine gas; (2) the control obtained over the perfect washing of the ore; (3) the small amount of labour, especially skilled labour, necessary; and 4 the small amount and simplicity of the machinery for the great amount of work accomplished.

One man of ordinary intelligence and a helper, are able to look after three barrels—charging, leaching, and discharging them. If the tailings are sluiced out no extra help is needed, but where they have to be trammed, one man in addition is necessary. The disadvantages are due to the neccessary construction of the barrel, but do not interfere with its successful working. They are principally the amount of space taken up by the filter and the portion of the barrel underneath, and the fact that when the barrel is charged and running it is not perfectly balanced.

These disadvantages can be partly overcome by placing the filter close to the shell, only leaving sufficient space underneath to allow of free circulation, but bringing it up to the same height on the sides of the barrel as the horizontal filter; then, by using compressed air to displace the solution and wash-water, an equally good result can be obtained.

For the collection of the solution two tanks are necessary, each of ample capacity to hold a day's solution from all the barrels. Those for collection are placed on the same floor as the chlorinators (unless fall can be secured to place them below). On a step below are the precipitation-tanks, which should be of the same capacity and number as the collecting-tanks. The limit to size would probably be 50 tons capacity; where more is treated, another battery of tanks would be necded.

For a precipitant Mr. Rothwell recommends hydrogen sulphide gas generated from paraffin and sulphur or from iron sulphide and sulphuric acid as the cheapest and most satisfactory. It is generated, and then forced through the solution with a small air-pump, which at the same time forces air through, keeping the solution-tank in an agitated state and expelling any free chlorine gas. To save time the gas is turned into the tank while it is filling up, so that, when the tank is full, a few minutes finish the precipitation and collection. The tank is now allowed to stand two or three hours, when it will have settled sufficiently to allow of the supernatant liquor being drawn off through a filter-press. There is little danger of precipitating arsenic and antimony which may be present when the process is worked cold, as they do not commence to come down till some time after the gold has been precipitated and collected.

This precipitant would not be, however, desirable with any considerable quantity of copper or lead in the solution, but small quantities can be dealt with in the after-treatment.

The loss in gold is considerably less if the precipitate is allowed to accumulate in the tanks, and a clean-up made after six or ten precipitations than if it were filtered

* *Eng. and Min. Jour.*, New York, vol. lii., page 698.

† For this purpose a lead valve is arranged in the barrel, so that not only the pressure of an excess of chlorine gas but its actual presence can be ascertained at any time. It does not do to trust to the pressure test alone, other gases being sometimes given off.

* *The Queensland Mining Journal*, Nov. 5th, 1888.

through a press and collected after every precipitation. There does not seem to be any advantage derived from a continuous precipitation and collection on this account if hydrogen sulphide gas is used, as the filters will soon become so coated and clogged with the sulphides as to retard rapid filtration without extreme pressure, which is sure to increase the loss.

The handling of a large number of filter cloths is also a source of loss, no matter how carefully done. The asbestos filter-cloth under ordinary conditions will last 100 charges, and can be changed in about an hour and a half; one cloth has been known to last 150 charges.

The life of the supporting plates and grating can be made to equal the life of the lining of the barrel, and with barrels that have several thousand charges to their credit this shows little wear.

The latest suggested modification of the chlorination process appears to be that patented by W. D. Bohm, described and illustrated in the *New York Mining Journal* of December 31st, 1892. Briefly stated, the principles involved in it are a forced upward circulation of the solvent solutions through the powdered ore placed in a suitable vat, of special construction.

The circulation is maintained until the precious metals are dissolved, when air-pressure is applied above the charge, to force out as much of the solution as possible, wash-water being subsequently forced up from below, or admitted above the charge, and then forced out in a similar manner, the previous constant flow upwards having caused (it is stated) such a deposition of the sand as to allow the liquid to be expressed rapidly and cleanly. It is claimed by using a solution of chlorine in water, and circulating it in closed pipes and vessels, that a considerable saving of gas is effected, and that as rapid results are obtained as with agitation, with much less power and wear and tear, while ores of different character can be treated in a short time and with little labour.

The plant is said to be equally applicable to cyanide treatment; the precipitation of the gold being effected on shavings of an alloy of zinc and sodium is claimed to be more efficient than zinc alone. The chlorine water is circulated through the ore in a manner similar to a cyanide solution. It is claimed for the electrolytic chlorine-producing apparatus, the invention of two Russian chemists (which is worked in connection with this process), that a great reduction in the cost of producing chlorine is effected; that common salt will supply the place of sulphuric acid and chloride of lime, that the machine is simple, requiring no skilled labour, and has been running with success at the El Dorado mine, Siberia.

This plant, in charge of an engine-driver, produces 40 lbs. of chlorine gas from less than 150 lbs. of common salt, utilizing 5 horse-power. The results are vouched for by M. Leon Perret, mining engineer to the Imperial Russian Government.

A diaphragm-pump of special construction prevents any emulsified grease or other undesirable matter from getting into the solution, and stops leakage of the gold solution through defective glands, etc.

The cost of working this process is stated to vary with the locality. Kaolin ores of Mount Morgan have been treated before the erection of the electrolytic chlorine generator at the following cost :—

	s.	d.
10 lbs of bleach, at 4 cents	1	8
8 " acid, at 2 cents	0	8
Labour and power	1	9½
	3	9½

The time occupied for each charge being 4 hours.

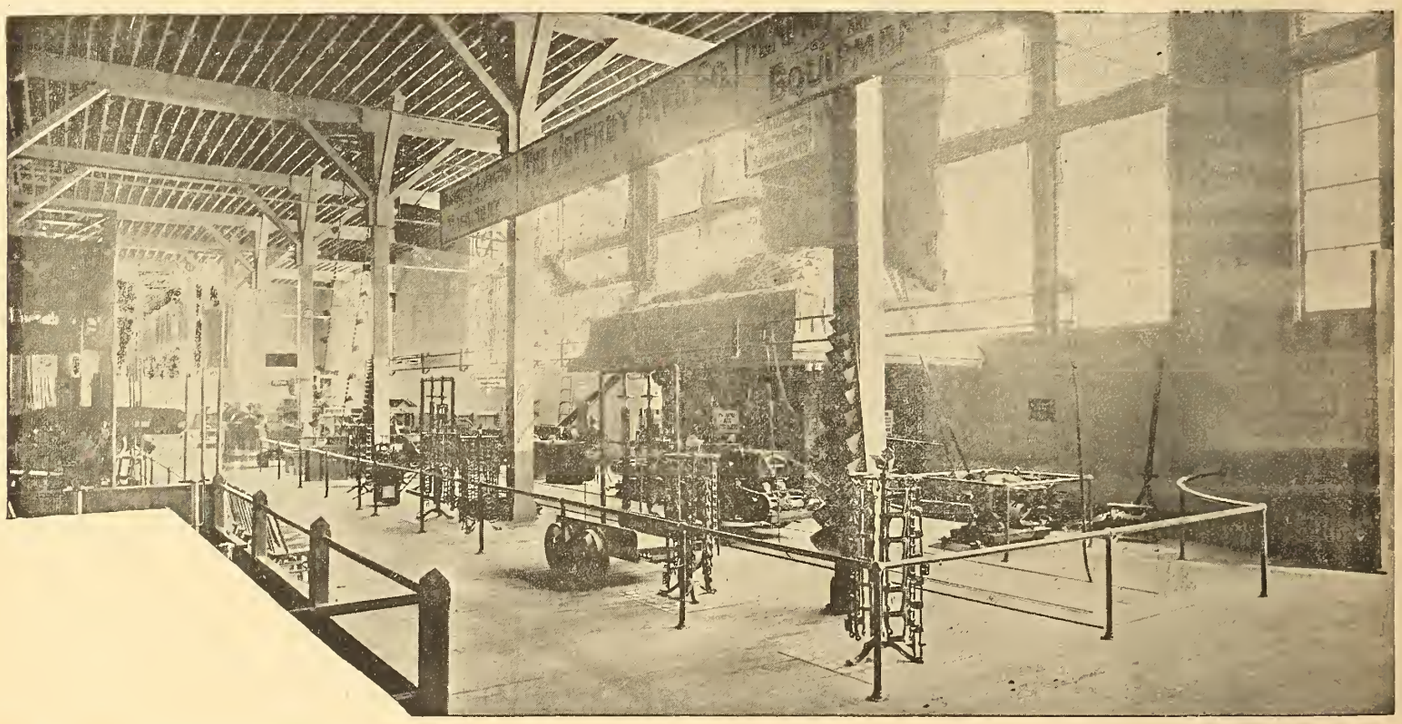
The extraction is not stated, but a proportionate increase in cost of chemicals would be necessitated in the treatment of ores requiring more chlorine.

Mr. Claude Vautin mentions, as recent useful innovations, glass-lined iron pipes, manufactured by Messrs. D. Rylands & Co.; enamelled iron diaphragm-pumps for conveying corrosive solutions, made by Messrs. Scott & Sons; and a compound containing upwards of 75 per cent. of available sulphuric acid, solid below the temperature of boiling water, which can be packed in iron drums, and shipped as ordinary cargo (obtainable from the Ore Dressing Co., 42, Old Broad Street); also chloride of lime packed in specially prepared iron drums. The form in which these two latter reagents are sold may be of utility to persons employing the chlorination process, especially in localities distant from a railway where transport has to be taken into account.

Mr. T. R. Rose,* commenting on Mr. Vautin's statement "that precipitated sulphide of copper is not to be recommended as a practical precipitant for gold, owing to its physical condition, and the facility with which it is oxidized to sulphate of copper," says :—"In accepting this statement as correct in a certain limited sense, it must not be forgotten that the suitability of the precipitant depends mainly on the manner in which it has been prepared. By adding a boiling saturated solution of sulphide (or rather a mixture of the polysulphides of sodium) to the equivalent proportion of a boiling saturated solution of sulphate of copper with vigorous stirring, sulphide of copper is precipitated in a granular form, which settles quickly in water. This substance is more active in the precipitation of gold than the fused sulphide. Its activity is due to the larger surface presented by the porous granules, and to the fact that it is easily decomposed. It is, as Mr. Vautin says, somewhat liable to atmospheric oxidation, but the loss, owing to this cause, is insignificant, because it is always kept covered with water, and can only take up such oxygen as may be dissolved in the latter. The granules of the sulphide of copper can be made the size of peas under favourable conditions, and there is no practical difficulty met with in precipitating gold rapidly and completely by their use. A point in favor of the fused sulphide of copper is the readiness with which it can be obtained, and as it has been proved to answer well, there is no reason why it should be rejected in favour of the precipitated salt."

(*To be continued.*)

* *Mining Journal*, March 11, 1893, page 276.



Mining Machinery at the Worlds Fair—The Exhibit of the Jeffrey Mining Co.

Situated in the North-east Section, ground floor, of the Mines and Mining Building, may be found the extensive exhibit of the Jeffrey Manufacturing Company, of Columbus, Ohio, who are acknowledged to be the authority on machinery for mining and handling coal.

This Company was organized in 1877, and have bent all their efforts towards the best and most economical methods of coal mining. Their space in the Mining Building comprises 1,500 square feet of floor, on which they have placed samples of their mining machinery. Their exhibit might properly be divided into two parts. First, the Mining Department, in which they show the Jeffrey Electric and Air Power Under-cutting Machines, Electric, Air Power and Hand Rotary Coal Drills, Electric Pump, Electric Truck, Dynamo, etc.; while in the other, or second department, they show complete handling device for the elevating, screening and conveying of coal. To better show the position and conditions under which their machines operate, they have erected an imitation of a coal bank showing the formation and strata of an ordinary coal seam. By this ingenious arrangement they have made it possible to show their machines in actual operation. As this Company was the first to build and now has the only successful electric mining machine, their exhibit is of special interest. Seeing the advisability of being able to show operators, and those interested in coal mining machines, at work, they made arrangements with the Exposition authorities, at considerable expense, whereby they might have ample amount of power continuously at their service.

To more clearly describe the coal cutting department of their exhibit, we beg to go over, in detail, some of the machines here shown. On a suitably arranged track extending the full length (60 feet), of their space, is a truck bearing a complete Electric Mining Machine, which mining machine is connected to trolley system of their own construction, by the means of which they are able to move mining machine with perfect ease. This device is shown to demonstrate the simplicity and ease with which the machine may be moved from one room to another in mines, after the machine is through making its cut and is ready to be moved to another room. At one end of track mentioned above, they have a movable Electric Pump on truck, which pump is admirably adapted to the purposes of pumping water in mines from dipping room or entries. To prove the practicability of this pump, the Jeffrey Manufacturing Company has placed a tank of water under floor, and by means of suction and discharge hose can keep a constant stream passing through the pump. Fastened to the roof of their mines they show Electrical Drill in operation, while along the front of their space on racks may be found both positive and air feed coal drills which are operated by compressed air, also several different patterns of hand drills.

To give a better description of the elevating, screening, and conveying devices shown, than can be gotten from the photograph, which accompanies this illustration, we give the following explanation: Located below the floor at one end of their space is a cast iron boot, from which, to the gallery above, extends a single chain elevator with malleable iron ore buckets placed on same about 24 inches apart. This elevator discharges into a revolving screen, which is hung from the gallery, which revolving screen is constructed in a substantial way and is covered by three different meshes of steel wire in order to make the proper separations of the coal. At the opposite end of screen, from elevator, the material is discharged into drag conveyor. From this conveyor the material is delivered into hopper, which, in turn, delivers it on to picking table and from there, by means of screw conveyor, the material is returned to boot. As all these devices are in continuous motion and running in unison, the material which they handle is constantly being passed from one device to another.

Thinking it might be of interest to those interested in this line of coal handling machinery, they have on display a large number of the different sizes and styles of chain belting for all conceivable purposes, such as conveyors, elevators, drive belts, etc.

In charge of this exhibit are men who are practical in their department and able to give information and useful hints to all who may be interested. They have, also, a large collection of blue prints of drawings showing special designs, which are of great interest to operators.

The foregoing description is extremely meagre, as it is impossible, in this limited space, to give any comprehensive description of the workings and construction of the different machines and devices shown, which descriptions are fully given in complete mining catalogue gotten out by this Company, and which will be mailed to all interested parties.

MINING NOTES.

(Continued from page 153)

After running through 300 tons of ore, the owners of the Poorman mill on Eagle Creek, near Nelson, closed it down until next spring. The reason given, lack of water. The 300 tons yielded gold bars valued at over $6,000.

Work has been suspended for a little time, but there is no knowing how soon the pick may be taken in hand again. Mr. Leslie C. Hill, the engineer, has given us a few notes concerning development work; the showing is extraordinary, and looks well for the future of silver lead mining in that country. "A cross cut run from 60 foot level in main shaft cut the vein 14.6 wide, nearly perpendicular. This is well defined but shows little mineral. There seems to be a horse of diorite at this point. North of shaft, vein is exposed for 257 feet hy two surface cuts. Vein is about 30 ft. wide, carries carbonates and galena. The galena assays 70 oz. A winze is sunk thirty-six feet in and cut through carbonates and galena, and there is good galena in the bottom; 137 feet south of this shaft a drift is run across the vein. The vein is 63 feet from wall to wall; all carbonates and galena. There are four feet of solid galena in foot wall. The vein in this winze is straightening up, and there is from 6 to 10 inches of soft clay gouge in the foot wall. In the south drift there is about 20 feet of backs. Another drift is started 150 feet further south which will have about 50 feet of backs. This drift has not reached the vein yet but there are boulders of float, and indications show that the vein is not far off. The ore body is proved for 400 feet, with an average width of about 30 feet, and the lowest depth is 36 feet, with good ore on the bottom. Twenty thousand tons of smelting ore can be taken out now.

(From the Miner.)

The news from the Trail Creek country continues to be of a very encouraging nature. All of the principal claims are being worked to a greater or less extent, and generally with good results. On many of the properties preparations are being made to continue work all winter.

Recent development work done on the Cliff claim, the property of Thompson & Wharton, has brought to light one of the largest ore bodies ever uncovered in the camp. The ledge matter runs from twelve to thirteen feet in width, and assays have been secured ranging from $39.50 to $41.62 in gold per ton.

The O. K. claim is making a record for itself of late. A strike was made on this property a few days ago, and out of one pocket six or seven hundred dollars were pounded in a hand mortar in a few days. A crusher which was ordered some time before the new strike, is expected soon, and when it arrives a force of men will be put on and the property opened up in good shape.

Some favorable looking ore is being taken out of the Homestake mine No. 2. The ledge is well defined and in a good formation. The ore body is about four feet in width, and samples have been secured that assay $30 in silver and $28 in gold.

The first carload of ore ever shipped from the Boundary Creek district was sampled at the Tacoma smelter during the past week. There were 385 sacks in the lot, weighing in all 21,000 pounds. At current quotations the ore carried over $160 in silver, and $100 in gold per ton.

Howard C. Walters reports that the Tacoma smelter is still in active operation, but produces only $3,000 worth of bullion daily, as against double that amount when the slump is silver. "It is," said Mr. Walters, "decidedly creditable to the management that the smelter continues in operation at all, and the miners of the north-west would regard its suspension as little less than the crowning adversity of the year. At present the purchases of ore are limited to actual requirements for mixing with the ore on hand, and to the product of districts that were shipping to Tacoma when the other smelters closed down. The regular weekly report from our superintendent in the Boundary Creek district indicates that the Providence and Skylark claims are doing handsomely, and we will continue shipments as long as the smelters can purchase ore. If silver is further depreciated, or is made a fluctuating article like copper or lead, the silver smelters will be compelled to go out of business entirely as they are obliged to buy large stocks of ore six to twelve months in advance of actual use and will not be able to quote prices and terms of payment that will enable sale of ore necessary to the operation of the mines. This fact many people do not understand, and affords one of the greatest reasons why silver can not be ruthlessly pushed aside, for with suspension of the silver smelters and mines will come such a great diminution of the annual gold product that the white metal must speedily be restored to its legitimate place in the coinage of the world.

Another rich strike of free milling ore has been made on Siwash Creek, in the Yale district. The locality adjoins the New Whatcom company's ground. The find is a decomposed quartz assaying as high as $130 per ton.

The Yale Hydraulic Company made a clean-up after a week's run a few days ago. The exact figures were not given but the result was announced as being of a very satisfactory nature.

New Explosives.—According to experiments by Cronquist (Ingeniors-foreningens forhandlingar, through the Oesterreichische Zeitschrift fur Berg-und Huttenwesen, vol. xxxix., p. 542.) the blows required to explode the following explosives, each about 0.4 gramme in weight, were approximately as follows:—

	Foot.		Pounds.
Nitro-glycerine	2.1	to	5.7
Dynamite	3.5	"	12.8
Gun-cotton, dry	5.7	"	
Gun-cotton with 20 per cent. moisture	16.5	"	
Sebastine	4.9	"	
Romite, common	4.3	"	
Romite, naval	13.7	"	
Powder (fired only)	271.2	"	
Bellite	448.4	"	

According to Lindall, on the other hand, plastic dynamite is much more useful than romite or bellite, which are also very much lighter—as much even as 40 per cent. Comparative experiments between plastic dynamite and bellite which were made near Stockholm, showed advantages in favour of the former, though Cronquist states that bellite shows not the least trace of flame on explosion. A mixture of 20 per cent. of dynamite with 80 per cent. of ammonia powder is also stated to be a very safe explosive as regards freedom from flame.

Nordenstrom observes that explosives, such as romite and bellite, which contain hydro-carbon derivatives, have as yet been comparatively little used in metal-mining. Fifty tons of romite was used at Gellivaara, but details are not available. These explosives are of little value for wet holes, and require much stronger caps than those usually employed. On the other hand, their transport is a matter of very little danger.

According to E. Pellissier, (Revista Minera, Metalurgica y de Ingenieria, vol. xlii., pp. 306-308.) comparative trials have been made in the district of Linars, Spain, of an explosive called nitramite and gelatine dynamite. In hand-boring the nitramite, though somewhat less powerful in its action, showed a saving in the expenditure, and this saving became considerable when compressed-air boring was employed. In this case, too, the work performed in the twenty-four hours was greater in the case of the nitramite than when dynamite was used. The tunnel being driven was advanced in the twenty-four hours 33.39 inches when dynamite was used and 34.97 inches when nitramite was employed, the respective costs being 2s. 11d. and 2s. 6d. per shift. The author observes that the action of the nitramite, though less violent than that of the dynamite, is more shattering. He recommends that in using nitramite, the cartridges should be placed well home in the bore-hole and in intimate contact with each other, but not in any way compressed. The detonator must not on any account be allowed to detach itself during the charging of the hole from the central portion of the cartridge, as this has a different composition. If there is water in the bore-hole, extreme care must be taken that none of it penetrates into the cartridge or detonator. This requires peculiar care if the charge is to be fired after filling the bore-hole with water. The chief experiments in Spain with this explosive have been carried out at the Arrayanes mine, under the direction of P. P. de Uhagon. The rock hored through in the experiments to which reference has been made was granite in the case of the handboring, and vein-stuff with some granite intrusions in the case of the machine-drilling

A commision appointed by the Belgian Government has recently experimented with a new explosive. This is stated to be named "Fortis," and to be from 30 to 40 per cent. more powerful than any other explosive known. A comparatively small charge placed in a 13-foot bore-hole in the face of a quarry dislodged a mass 200 feet in height, breaking it up into pieces mostly of from 50 to 60 lbs. in weight, and hurling some of these for a distance of 350 yards. (Iron Age, vol. xlviii., p. 523

O. Muhlhauser, (Chemiker Zeitung, vol. xvi., p. 163), describes an explosive made from hemp and named nitro-hemp, (nitro-jute. It is produced by treating one part of hemp with fifteen parts of nitro-sulphuric acid at a temperature of 15° C. After washing, this material is a brownish-yellow silky-looking wool, having the composition $C_{12}H_{15}O_5ONO_{25}$. It is insoluble in water, ether, benzine, or alcohol, but is soluble in acetic ether and nitro-benzine, or partially in ether-alcohol. In its explosive action it is almost indentical with gun-cotton.

A new explosive named "Nico" has been tried at the Corporation quarries, Clifton Hill, Melbourne. A 4-foot hole in the toe of a solid piece of rock was charged with 1¼ lb. of cartridges and a little loose powder, the hole being too large for the cartridges. A second hole 6 feet deep was similarly charged with 2½ lbs. of powder, and a third with 21 lbs. Each of these shots gave successful results, as also did a number of others. (Australian Mining Standard, vol. vii., p. 201).

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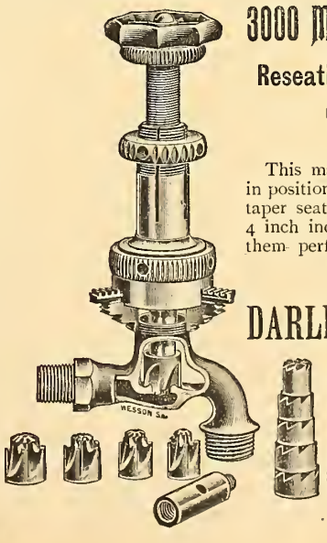

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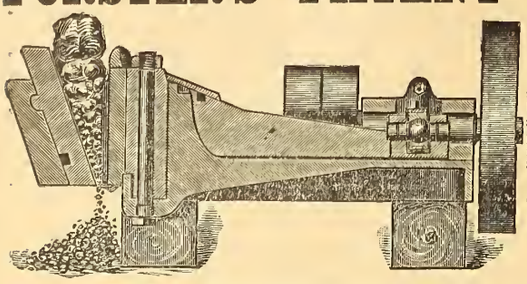

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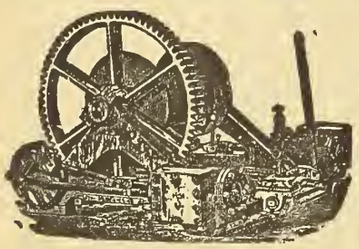

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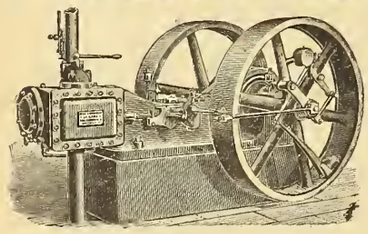

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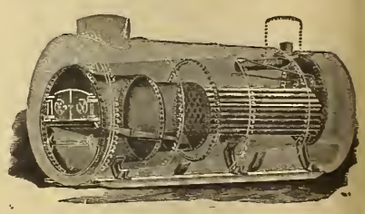

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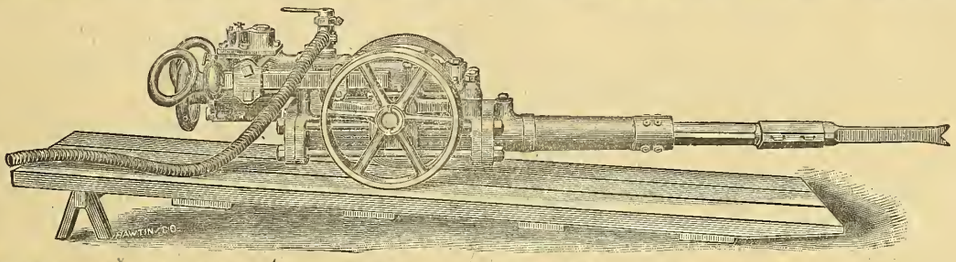

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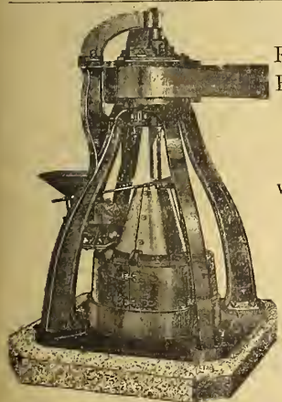

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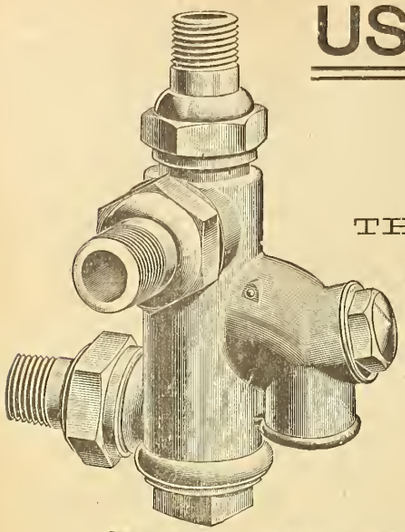

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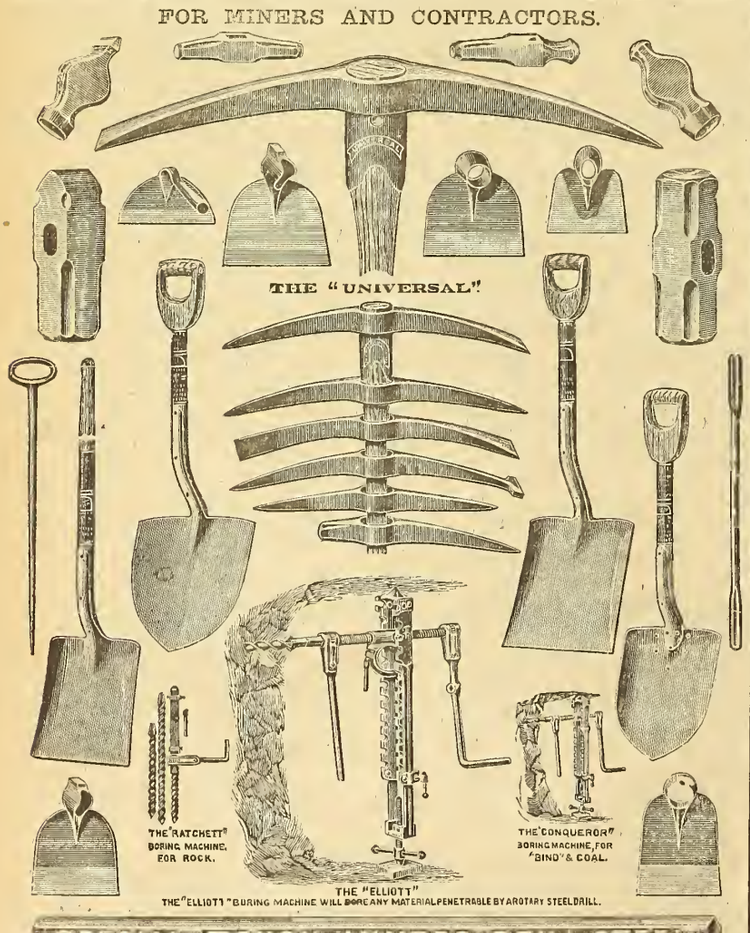
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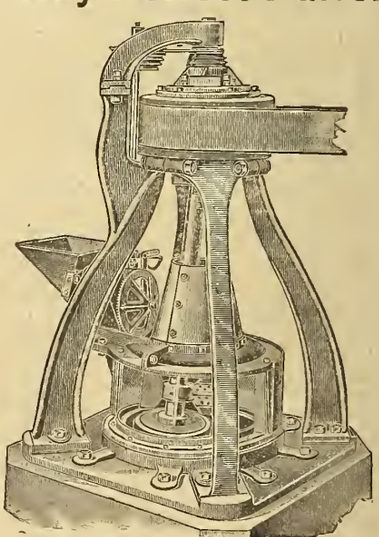

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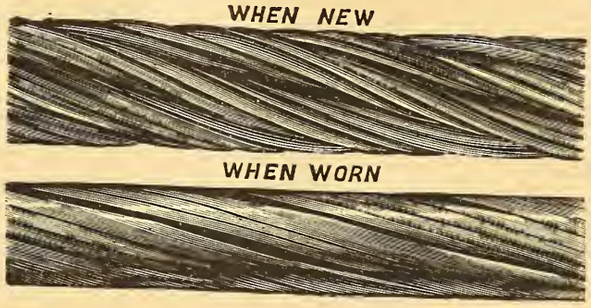

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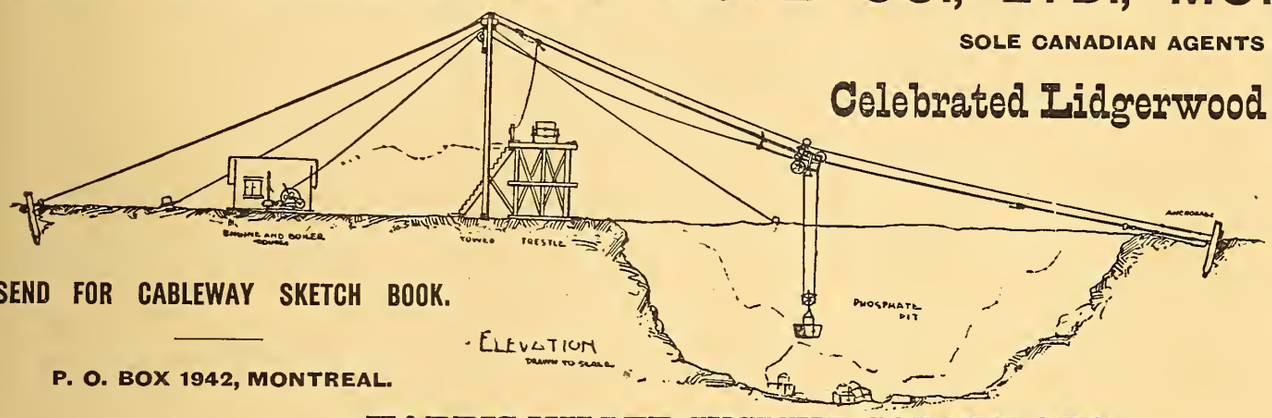

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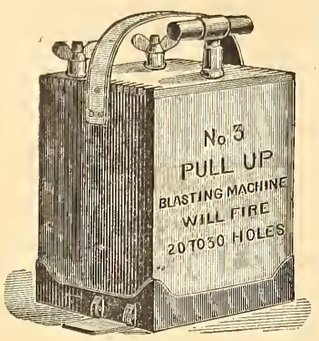

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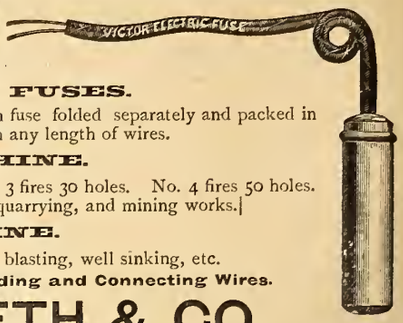

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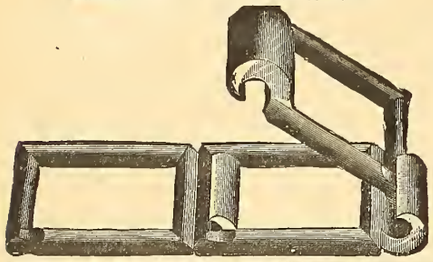

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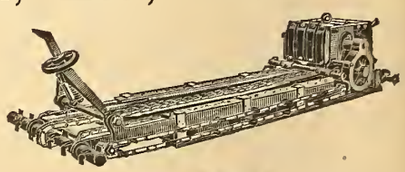

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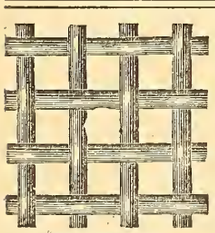

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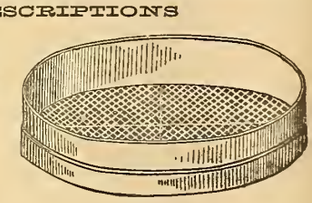

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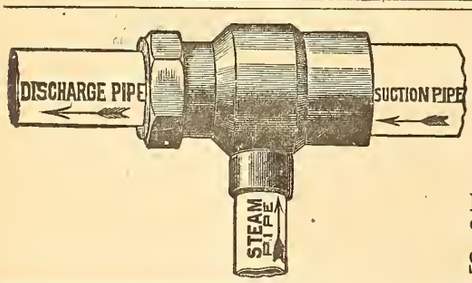

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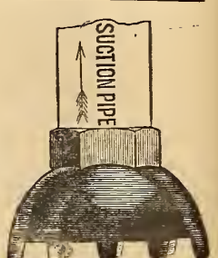

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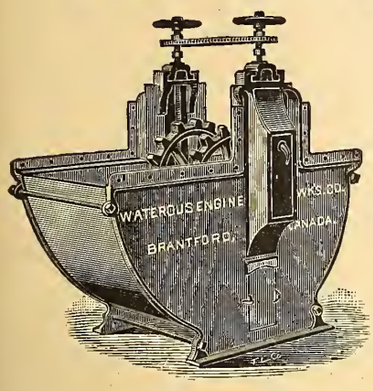

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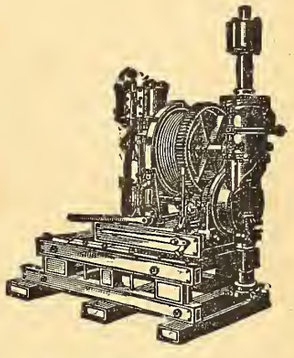

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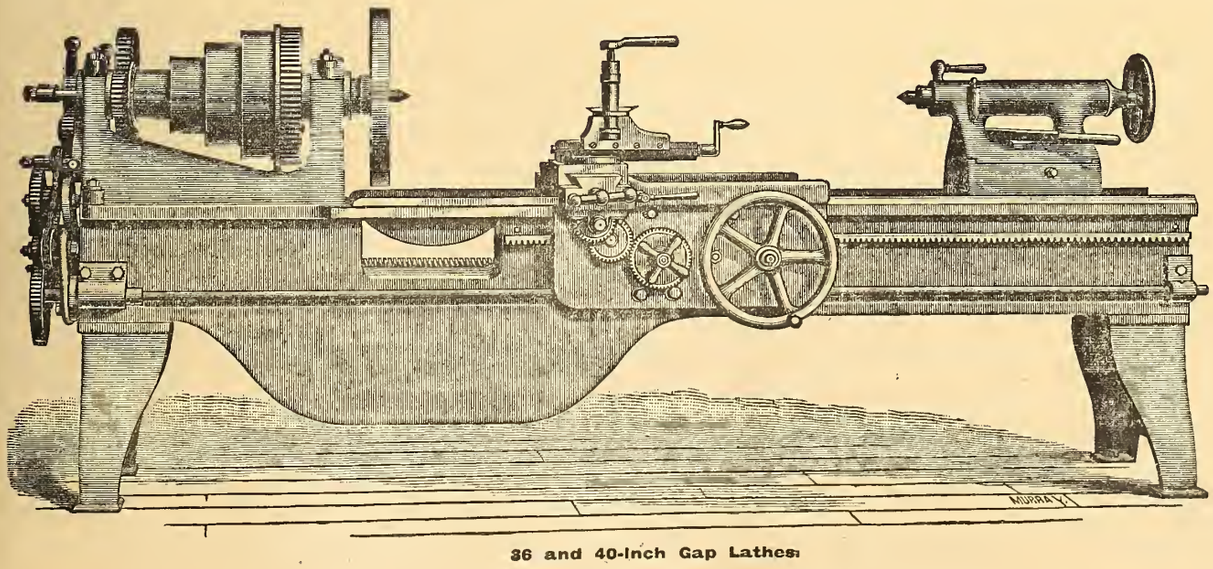

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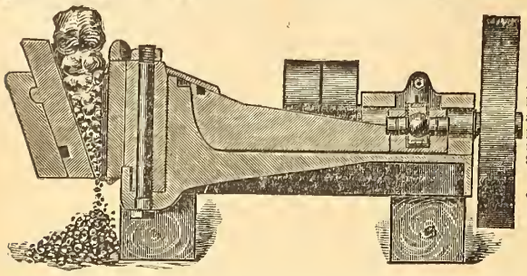

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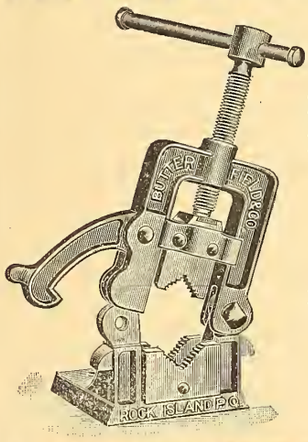

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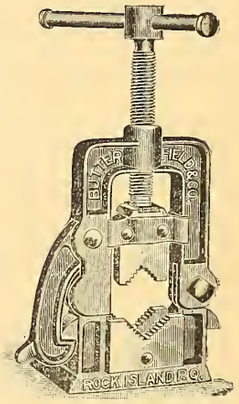

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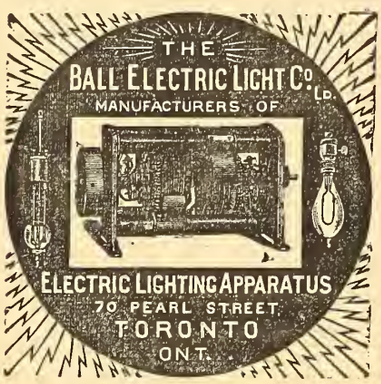

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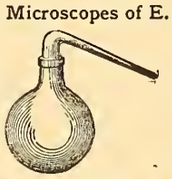

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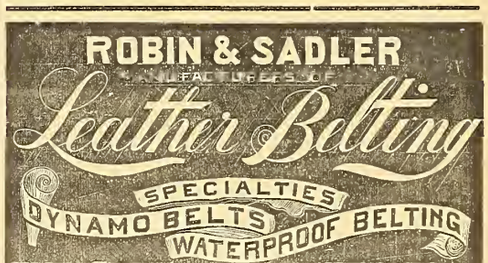

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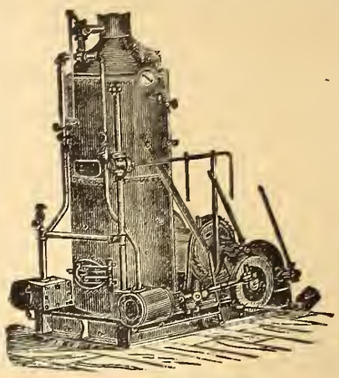

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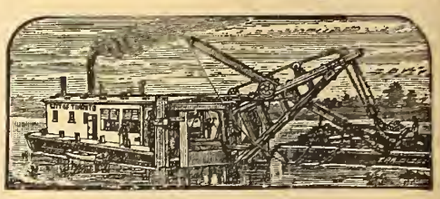

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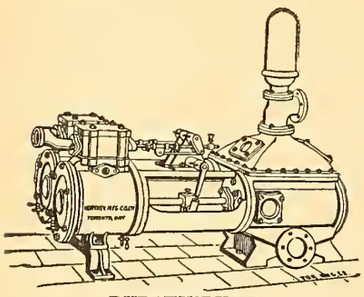

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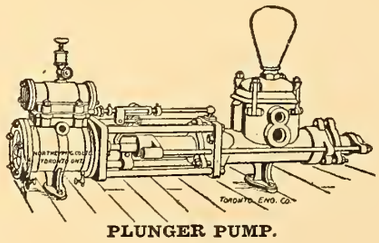

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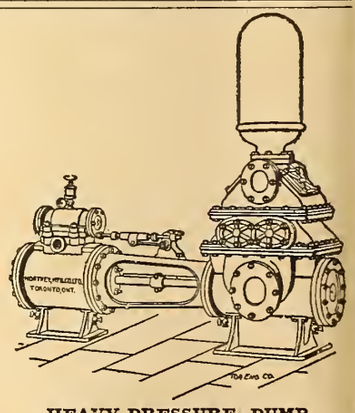

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Vol. XII. OCTOBER, 1893. No. 10.

THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEEEC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The late Mr. W. H. Irwin.

It is our painful duty to record this month the death of Mr. W. H. Irwin, which occurred at his residence in Montreal, on Sunday, October 1st. The deceased gentleman was a partner in the well-known firm of Irwin, Hopper & Co., dealers in asbestos, and at the time of his death was a director of the Anglo-Canadian Asbestos Co. (Limited), the Montreal and Kootenay Mining Company (Limited), and the English Portland Cement Company (Limited). To the mining men of the Province of Quebec, he will be long remembered for the prominent position he took in all that affected the welfare of the industry, and particularly for the energy and zeal he displayed in promoting the abolition of Mr. Mercier's obnoxious mining law, the tax on powder magazines, and other legislative measures. He was one of the first to advocate and further the formation of the General Mining Association of Quebec, and by his untimely death the members of that body mourn the loss of a wise counsellor and firm friend. He took an active part in the proceedings of the International Mining Convention at Montreal in February last, being foremost in promoting and carrying out the arrangements for that meeting and in entertaining the visitors. Indeed, we are informed that his death is directly traceable to this event, for a cold contracted on the toboggan slides with a party of guests developed into an attack of pleurisy from which he never recovered.

The deceased gentleman, who was only 38 years of age, married about twelve years ago a daughter of the late Mr. Johnson, Assistant Commissioner of Crown Lands for the Province of Ontario, by whom, with one daughter, he is survived. The REVIEW joins with every member of the General Mining Association of the Province of Quebec, and the mining men of the country, in tendering to Mrs. Irwin an expression of sincere sympathy in her sore bereavement.

The late Mr. W. Hall Irwin.

Bimetallism — Rothwell's International Monetary Clearing House a Chimera.

The fundamental condition underlying any attempt to create a double standard of value, is the possibility of maintaining an exactly equal value for given quantities of two separate metals, that is, that an ounce of gold shall always be equivalent to a certain number of ounces of silver in the denominations by which money is known; in such a way that whoever has a payment to make or a debt to receive, it shall be a matter of absolute indifference whether he gives and receives this in gold or silver (or in paper certificates of either, or paper promises to pay either).

It need not be stated that the actual unit of value in every country is a certain definite weight of metal. It is important that this should be clearly understood, and that this has come to be so through the varying influences operating for many centuries in the region of commerce and banking; for the all dominating reason that while the *value* of anything is a fluctuating and uncertain quantity affected by many influences constantly working in millions of minds and finally resulting in what is called "supply and demand," the *weight* of any commodity that can be handled is a fixed and determinate thing. Not all the influences in the world put together can make an ounce of silver more than an ounce, or a pound of copper more than a pound. There are fixed standards of weight in every country, by whatever names these weights may be known. These are capable of being made so definite as to be absolutely unalterable. Similarly with anything that is estimated by its bulk, any commodities that can be *measured* are susceptible of definition that is absolutely unalterable. An inch, a foot, a yard, are certain properties of matter which are determined by unvarying and invariable standards, and no conceivable circumstances can make any change in them. No law of supply and demand has the slightest effect upon the length of a piece of cloth, or the weight of a bar of iron, or of an ingot of gold or silver. When, therefore, contracts are made to buy or sell so many tons of iron or so many yards of cloth, the quantity can be exactly estimated inasmuch as their denominations must conform to fixed standards in possession of the government of the country. Weight on the one hand, length, breadth or thickness on the other are properties inherent in material bodies, and nothing can alter them.

Now, these weights and measures, so far as the denominations are concerned, are purely arbitrary as between one country and another; yet, within the same country they must perforce be precisely the same. Every country has somewhere a legal standard of length, and a legal standard of weight, and these are purely matters of legislation. The legislature of any country, if it so pleased, could make its standard of a foot to be six inches longer, it could make an inch equivalent to two inches, it could make a yard as long as a yard and a half. But then this standard would require to be universally adopted and understood throughout the country, or the whole of its exchanging or trading operations would be thrown into confusion, and it would require to make known its standard to other nations of the world, or its trade with them would be thrown into disorder. In practice, such things as attempting to alter measures or weights and make them longer or shorter, heavier or lighter, is unknown, for no possible object would be attained by it to anybody.

But when we enter upon the region of *value*, we are in a world of ideas of an altogether different kind—for value is not inherent in anything whatever. Value is in the mind of man—it is a purely mental conception—it does not inhere or form part of the substance of the thing itself. A bar of iron can be measured, and its length, breadth and thickness are unalterable—it can be weighed, and its weight is unalterable. A bar of silver can be subjected to the same process, so can a nugget of gold. But the value of that bar of iron is a mental conception, and that mental conception is subject to a thousand changeable influences. It may be one thing in one man's mind and another thing in another's—in fact, this changeable conception and the difference

between one man's mind and another man's mind is the foundation of all the bargaining and higgling that takes place in trade. This mental conception, too, may be different to-morrow from what it is to-day, and different as between different individuals. A man's mental conception may be different from that of yesterday in one direction, while another's may be different in the opposite direction. The play of all these divers influences is expressed by the varying figures that (like a thermometer) measure the heat or cold of the market, the desire or absence of desire of persons to get or to part with any commodity, ranging from the utmost eagerness to get, to the utmost eagerness to get rid of—midway been which is a state of perfect indifference. All these influences are operating every day with regard to every commodity that is used by mankind, and operating all over the world in tens of thousands of minds, giving rise to tens of thousands of conflicting thoughts, which finally settle themselves in the markets of the world, in certain figures which are called prices, which prices are just the final result day by day of thousands of conflicting mental conceptions. It would be vain to attempt to arrest this process as carried on day by day all over the world; that is to say, it would be utterly futile to attempt to fix a permanent exchangeable value for any commodity in existence.

It is here we touch that very interesting old problem of the limitation of legislative power.

The legislature of any given country has the power to regulate Weights and Measures, but if any Government were to attempt to regulate the *value* of any material commodity that can be weighed and measured, it would find itself baffled by the varying operations of these mental conceptions in the minds of men, arising out of changing circustances of the world from day to day.

Let us illustrate. The Congress of the United States could, undoubtedly, pass an Act that a bushel should be larger or smaller than the standard bushel now in use, and when this was universally known, everything within the United States would adapt itself to the change. But if Congress were to follow up this by decreeing that everywhere throughout its jurisdiction, a bushel of wheat should be exchangeable for a dollar, what would ensue? (We must carry out our illustration and suppose this law in effect for several years in which changing circustances and elements come into play.) There might be a time, and we will suppose that that time coincides with the passing of the Act, when in the produce exchanges of the United States the higgling and bargaining between the man who wanted wheat, and the man who wanted to part with it, had settled into a quotation of a dollar for a bushel. But the quantity of wheat in the world is constantly changing—an enormous quantity is consumed every day, and an enormous quantity of new growth is taking place every day. It is upon men's calculations and opinions of the operations of these two forces that the price in the open market is determined. Now, let us suppose, (and such things do happen, it is not mere fanciful supposition) that the course of growth which finally results in harvest, is of such a character that the world has a very large supply. Those who have the commodity in the United States, find that the Government has established, that they can exchange every bushel of it for one dollar. So far, so good. But no bargain can be concluded without the intervention of two persons. There must be a buyer, as well as a seller, and in the mind of the buyer there will arise the conception that this quantity of the wheat is not worth a dollar, seeing that an equal quantity can be purchased abroad for less than a dollar. The man who has the dollar will send it to another country, and the commodity will be brought in in the course of trade. But the man who has the wheat wants money in exchange for it—his want is money, his demand is for money; in fact, he must have money in order to live. The exchange of his wheat is a matter of life and death to him. He will, therefore, under the operation of that necessity which knows no law, undoubtedly, part with his wheat for less than a dollar. On the other hand, if the process of growth results in a small crop, those who have wheat will find that persons who have money are very eager to get their wheat, and are ready to part with more than a dollar for a bushel of it. They would, in that case, undoubtedly, refuse to sell for a dollar; and as the eagerness of the buyer increased, it is certain the barriers of law would be broken down by the necessity of things. Unless, therefore, the law were to go so far as to impose penalties for every bargain that did not conform to its requirements, and unless the United States closed its ports to the whole outside world, for commodities whose value was fixed by law, it would be impossible for a single day to maintain a fixity of value. But these suppositions are both of them an absurdity. Any absolute monarch that made such decrees would be dethroned, and any legislature would be turned out.

Exchangeable value, then, cannot be determined by the action of a legislature without such further arbitrary and despotical conditions as would put an end to the legislature itself. In fact, it may be set down as an axiom that no action of any government has power to maintain the exchangeable value of any existing commodity. To this it may be replied that the government of England has done this very thing which is declared to be impossible; namely, it has fixed the value of an ounce of gold at a certain sum expressed in sterling figures.

But it will be obvious, in considering this matter carefully, and looking beneath the surface, that what the government of England has done in reality is simply to *determine the weight of the coin* which represents the pound sterling. This coin is called a sovereign, and consists of a definite weight of gold, very nearly a quarter of an ounce. The government stamp on this piece of gold is a warrant to the holder that the metal is genuine and that it is of a certain weight, nearly a quarter of an ounce. The value of an ounce of gold is fixed by law at £3 17s. 10½d. It will be obvious that so far as the gold is concerned, any sale, so called, is simply the exchange of a lump of gold of a certain weight, *for the coins that can be made out of it*, and is no proper exchange at all. But with regard to the shillings and pence, it may be contended that here is a *bona fide* exchange of one metal for another metal in such a way as to fix a relative price between the two. By the same law which ordains that an ounce of gold shall always be worth a certain sum of silver, it is ordained that twenty pieces of silver of a certain definite weight and with certain government stamps, shall be equivalent to a pound sterling. Here, it may be contended, is a genuine and perfect example of two metals passing current side by side, whereof a definite weight of one bears a definite relation of value to a definite weight of the other. This argument however plausible though it be will not stand the test of examination. For these silver coins, whereof twenty are declared to be equivalent to a certain weight of gold, are only allowed by law to pass current at that value in the shape of pocket money. As much silver as a man can conveniently carry in his pocket, viz., £2 worth, and with which he can make the small purchases of life, is allowed to be current at a definite value as compared with gold. This so-called value is purely arbitrary and limited. There the legislature has stopped, and has stopped by force of circumstances. No man can gather up a quantity of these silver coins exceeding £2 in value, and demand gold in exchange for them at the fixed ratio. Any man in England can buy one pound's worth of an article or pay a debt of £1, either with the gold sovereign or with twenty silver shillings; and he can go to the extent of £2 in this direction, but no further. He could not discharge any debt deserving to be called a commercial debt with silver. The law does not allow it. The Bank of England could not give one hundred of these silver coins in exchange for one of its promises to pay £5, and there are no smaller notes current in England. The law allows none of the operations of commerce to be carried on on a silver basis; still less the operations of banking. *The silver coin is nothing but a silver token*, and the fluctuations as measured in gold in the value of the metal, large as they are, do no harm whatever when the coins are restricted in their exchangeable value to such minute quantities. The same argument holds with regard to copper coins.

The silver shilling, then, being considered arbitrarily as a definite proportion of a single pound, which is a piece of gold, it becomes quite clear that the selling of an ounce of gold at the standard price fixed by law, is simply the exchange of a piece of gold of a certain weight, for three or four other pieces of an equal weight, with the government stamp affixed to them; that is, it is an exchange of gold for gold, which is not a commercial operation at all, and has nothing whatever to do with value. *A* has a bar of gold weighing one hundred ounces, *B* has a number of sovereigns weighing one hundred ounces. It is certain that *A* would not exchange

his bar of gold for *B's* separate pieces unless *B's* pieces were of equal weight with his bar, or so nearly that the difference in weight would simply represent the cost of melting the bar and coining it into the pieces requisite, and putting the government stamp on them. These operations are going on every day at the Royal mint and at other mints of the world. A gold bar can be changed into an equivalent weight of coins, coins can be transmuted into an equivalent weight of gold bar, and in these operations there is no question of a greater or lesser *price*, or increase or decrease of value, but simply of the cost of turning the weight of metal out of one form into the other, or *vice versa*; and the standard price is merely a way of expressing that the pound sterling shall always consist of a definite weight of gold, no more and no less, for which weight the holder of the piece of gold called a sovereign has the certificate of the government stamped upon it. If any person therefore says that the value of gold is this, that, or the other, as measured in gold, such language is meaningless. To say that a sovereign is worth a sovereign, or that £5 are worth £5, is mere nonsense. And it is equally meaningless to speak of the value of gold as changing, when measured by gold. We might as well say that the yard measure is longer when there is more cloth, or that a ton is heavier when there is more iron.

The unit of value, therefore, in England is this piece of gold weighing nearly a quarter of an ounce, and called a "pound." All monetary transactions in the British Islands are expressed in this unit, or in divisions of it. The divisions are arbitrary, but it is to be noted that they are represented by most convenient coins. The pound sterling expressed by a sovereign is a convenient coin. One twentieth part of that, the shilling, if it were made of gold, would be an excessively inconvenient coin, and utterly impossible of daily use; but a twentieth part of a sovereign expressed in silver is a very convenient form of money. The copper coin called the "penny" is simply as large a piece of copper as any person can conveniently carry in his pocket. The twelfth part of a shilling expressed in silver would be just as inconvenient as the twentieth part of a sovereign expressed in gold. Copper, therefore, comes in conveniently, and the penny is the unit of value in copper coins. But it must never be forgotten, as above shown, that silver and copper coins have no legal value beyond the amount that a man can conveniently carry in his pocket, that is, £2 sterling.

If then, it is proposed that silver coins shall be created as money, so that a definite weight of these coins without limitation shall be equivalent to so many pounds, the reply that must be given is that to maintain such a value in gold for the silver coins, would be impossible in the nature of things; just as impossible as to fix the value by law of a bushel of wheat, a ton of iron, or a yard of cloth.

But it may be rejoined, if all the governments of the world representing commercial nations, joined in an agreement that in their coinage and currencies a given weight of silver should always be equivalent to and exchangeable for a given weight of gold, would that not have the effect of causing it to be so? One single government, it may be contended, could not fix the price a which an ounce of silver shall be estimated in gold, or *vice versa*, and obviously for the reason that if the market was open to all the world, all the world would pour in supplies of silver if the price was high, and would withhold it from any country where the price was low. But if all the world joined in this agreement, then, the object surely could be accomplished. This is a plausible argument. But there is a fallacy lurking underneath this phraseology of "all the world." What is meant is the respective *governments* of all the world; not all the millions of individuals living under those governments.

Now the power of any government, it must be admitted, is limited. It cannot control all the actions of the millions of people that are subject to it, and especially in matters that affect the personal interests of individuals. It is certain that no government could compel all its citizens or subjects to buy and sell at prices fixed by that government. Government interferes with certain departments of trade in the way of excise, supervision and the exaction of customs duties. That interference is tolerated for the general good, and is in reality not burdensome. But for every government in the world to say to persons engaged in silver mining or silver trading, that their commodity shall count for so much and no more, in relation to the standard of value, would be an arbitrary interference that would never be tolerated.

The idea of this matter being determined at the beginning and constantly regulated hereafter by an International Clearing House or Committee, is a plausible endeavor to meet the difficulties that surround the question.* But the idea is chimerical. An International Clearing House, in the proper sense of the word Clearing House, is simply an absurdity. A Clearing House is a place where a definite number of persons, who have in the course of business, constant claims upon each other, can meet every day for the mutual adjustment and settlement of those claims. Such a clearing house can only, in the nature of things, apply to the merchants, brokers or bankers, of a single city, for even if it were attempted to have a clearing house for a single Province, or a single State, insurmountable difficulties would arise in its working. What then would be the difficulties of a clearing house for the whole of Canada, or the whole of the United States?—Still more if such a clearing house was proposed to embrace the whole world. It is obvious that there can be no more a single clearing house for the whole world than that there can be a single stock exchange for the whole world.

The idea, however, is not, strictly speaking, that of a clearing house at all, but of a committee of intelligent persons who shall settle this matter on a given basis to commence with, and determine that an ounce of gold is exchangeable for a certain number of ounces of silver, and then that this committee shall sit *en permanence*, and determine the same ratio from time to time, and deal with all the circumstances that might occur and disturb it. Now it would be perfectly easy to organize a committee for the purpose, provided men of sufficient ability had a sufficient inducement to set aside other engagements, and meet in some central place to consider the question. It would be easy for them to discuss, as has been discussed already, what this ratio should be. But experience has shown that the probability of their coming to an agreement would be extremely remote. Let us, however, suppose that an agreement was reached; and that it were promulgated throughout the world, that in the opinion of this International Committee, a proper ratio between gold and silver was so much, no more, and no less. That, however, would only be the initial step of a difficult business, for unless all the governments of the world, with no single exception, agreed to be bound by this decision, the meeting of this committee would be a mere academic meeting, and result in nothing but an academic opinion. But let us suppose that all the governments of the world, which is most improbable, agreed to be bound by the decision of this committee, and by all future arrangements and decisions of this committee, does any one suppose that in the multifarious operations of mining, commerce, banking, and exchange, going on day by day all over the world, that any government could pretend to *enforce* the decisions of such a committee, that they could by any possibility punish those who conducted their business without regard to its decisions, that they could fine or imprison the merchant or silver mine owner who differed in judgment in conducting his business. Such an idea is a transparent absurdity. On the first attempt to enforce by pains and penalties the decision of this committee, the whole mercantile world would be up in arms in every country, and demand from every government that the sittings of this committee and their arbitrary rulings should be put an end to.

We have looked carefully over the statements and proposals in this volume of Mr. Rothwell's and have come to the following conclusions about it:

First: There is in it an enormously exaggerated idea of the importance of the part played by gold and silver in the monetary transactions of the world. In all mercantile and civilized countries the actual handling of the metals is confined almost exclusively to the settlement of international balances—not international transactions by any means—but simply international *balances*. These balances are the merest fraction of the total transactions. In the vast volume of the monetary transactions of the United States, gold plays such an insignificant part, so far as actual handling is concerned, that it is

* This article has been suggested by a perusal of the work on "Universal Bimetallism," published by the Scientific Publishing Co., New York, written by Mr. J. R. Rothwell, editor of the *Engineering and Mining Journal*, New York.

scarcely ever seen. Still more is this the case in Canada. The monetary transactions of the larger class of banks in Canada amount to between five hundred millions and a thousand millions in a year. In all this enormous mass of transactions not $100,000 of gold will be handled, and often much less. Gold plays a part in Canada of less than one in ten thousand. The clearing house transactions of New York have averaged about 32,000 millions of dollars for several years back, all which was settled without the intervention of gold. The transactions of the London clearing house last year, reduced to dollars, amount to 35,000 millions, and though the gold sovereign is part of the daily currency of England, owing to the fact that no notes less than £5 can be circulated, even this prodigious volume of transactions was settled without the intervention of gold. The gold metal is a *support* to currency and business transactions, and furnishes the basis on which they rest, and also the standard by which they are measured. There, practically, its function ceases, so far as the United States and Canada are concerned. It is therefore an utter delusion to imagine that there exists any necessity to increase the stock of gold in consequence of some supposed action looking to the future de-monetization of silver. For in practice silver has long been demonetized in the United States, and it is demonetized both in practice and theory in Great Britain and in Canada.

Second: Mr. Rothwell has committed a very grave blunder in estimating the bearing of the use of silver in the countries of the world according to population. The population of the countries who carry on business on a silver standard alone is stated to be 67 per cent of the whole population of the world. But how much business, commerce, banking and currency have these hundreds of millions in China and India, as compared with the much smaller populations of European countries. Great Britain alone, with one-tenth of the population of China, has certainly at least ten times as much in volume of monetary transactions. And it is not to be forgotten that the whole of the banking carried on in these countries of vast population is by British banking institutions; and that all their foreign commerce has to be carried on on a gold basis.

Mr. Rothwell's treatise bristles with misstatements, misapprehensions, and delusive ideas respecting advances in the *value* of gold (we might as well talk of the advance in weight of a ton), reductions in the rate of wages, the possible demoralization in consequence of an increased demand for gold, and other matters, in all of which his ideas are contrary to the experience of the past, and to the actual developments of business and finance as we see them in the world to-day, and the idea of a double standard and of an international clearing house, so-called, to maintain it is not the least of these delusions.

It may be pointed out that in the table given of the approximate stocks of money in the world, some most astonishing blunders have been allowed to creep in. In the column containing what is supposed to be the gross total of money in the world, there is an entire omission of 810 millions for Russia, together with an error of 56 millions in the column for Canada, and 60 millions in the column for Cuba and Hayti. These gross and enormous errors should not have been allowed in a final revision of a work in which so much is made of figures. But we may be allowed to say that not the slightest dependence can be placed on the greater part of these figures, even where they are correctly printed. They are evidently, in many cases, the merest guesses, and to those who have practical knowledge of the subject, some of them look like very wide guesses.

EN PASSANT.

For having the temerity to protest against the notorious tardiness that characterises the publication of that much abused volume of mineral statistics issued by the Geological Survey, Mr. W. Hamilton Merritt has provoked the ire of the officer in charge and drawn from his pen a flood of sour and ill-natured verbosity. This labored disquisition occupies a full column in the *Empire* and seems to have involved the vocabulary of the staff. From all we can gather it occupied in its composition nearly as much time as the precious Annual Report itself. In parts it sparkles with the peculiar genius of the director; in others the master hand of "Honest John" has evidently been requisitioned to give that nicety of "twist and turn" (not the *in-turn*) for which the learned librarian is noted. To us it has had more than a passing interest inasmuch as, strange to relate, the greater portion is devoted to an exceedingly minute review of our *Canadian Mining Manual*—the number of its pages, the character of its contents, the known reputation of its contributors, yea verily even the price is not forgotten—facts, evidently quoted to give force to the remark that the *Manual* "in its own sphere of utility has many excellencies." Such gratuitous advertising does not come our way every day and we are profoundly grateful. The remainder of the letter is a fling at Mr. Merritt, somewhat offensive in its personalities. As a reply to his remarks it is a *complete failure.*

As if to justify and more fully emphasise Mr. Merritt's comments we have before us *fresh from the press* the Annual Report *for the year 1891*, the main feature of which, as in preceding issues, is its remarkable antiquity. Hoary and mildewed with age, it comes to us with its copious repetition of figures from Customs returns, and reprints from Provincial Mines Reports which, having been printed and distributed from their original sources nearly two years ago, are now practically obsolete and useless as an up to date reference. In 200 pages (including an index) we find little that is original or of value. Nearly *fifty* pages are culled holus-bolus from the report of the Minister of Mines for British Columbia for 1891; about *thirty* from Dr. Gilpin's report for Nova Scotia of the same period, while *ten* pages are given over to a reprint of Mr. Klein's paper on the asbestos industry read in July, 1891, before the General Mining Association of the Province of Quebec. Add to these the space occupied by the bulky reproduction of figures copied from the Custom's Reports and one can readily sympathise with the onerous responsibility entailed upon Mr. Ingall and his staff which requires such "careful compilation and therefore must take longer to complete and issue than those carrying less responsibility." Why we will undertake to furnish him with an office boy who, with little discrimination in the use of his scissors and paste, will reproduce three parts of his last Report inside of half an hour.

To the public and particularly foreign capitalists seeking investment in our mines and mineral lands, there is a real and urgent necessity for an official report which will provide them with information that can be commercially applied. A volume which, while reviewing yearly the status and progress of our mineral industries, will post the enquirer on known locations in which particular minerals are found and may be looked for in workable quantity, the history and operations of working mines, the methods of working and treatment, capital invested, labor and machinery employed, cost of working, statistics of output and exports, disposition and uses, market and freights of the year, and other particulars of a like nature constantly sought after by the new-comer with an eye to business. A report based on lines somewhat similar to these would be an immense boon to the country and would be of more real service and advantage to the mineral operator than a bushel of such antediluvian statistical trash as the volume at present before us. Doubtless there is truth in the contention of Dr. Selwyn that commercial data is beyond the jurisdiction of a Geological Survey. But surely one has a right to look for it from a Bureau or Division of Mines, supervised by a qualified mining engineer, and equipped with a staff sufficiently large enough to acquire and prepare it for early publication.

In thus commenting upon the Report, we desire it to be distinctly understood, that it is far from our desire and intention to cast any reflections, personally, upon the Chief and staff of the Division of Mines and Mineral Statistics. Mr. Ingall is well known to be a capable and efficient officer, and is held in high esteem by his fellow workers and the mining men of the country. During the past year too, sore family bereavement and a severe illness interfered greatly with the supervision and work of his Division. We

are well aware that his work is beset with many difficulties. The narrow and limited, and comparatively valueless lines upon which the Report is cast, were formulated before his day. But circumstances have changed. Each of the provinces has now its own Mining Bureau and its special mining officers, and armed with legislative powers which the Geological Survey does not possess, they are in a far better position to obtain and publish in their yearly reports, all the statistical information up to date, that is ordinarily required by the miner. If the Survey desires to keep abreast with the times and the requirements of the Canadian mining industry, it will proceed immediately to remodel this report. Perhaps we might suggest a careful study of that published by our cousins across the line, under direction of Dr. Day. Anyway, let us have a Report that will be of some use, and, above all, let its contents be fresh.

The many friends and acquaintances of Mr. Walter W. Pickford, for many years manager of the High Rock phosphate mine, and now superintendent of the Illinois Phosphate Co., Florida, were pleased to welcome him and his bride in their midst for a few days during a brief visit to Canada, on their way to Florida, from England. The REVIEW joins with Mr. Pickford's galaxy of friends in the phosphate business, in extending to him and his charming bride, its heartiest good wishes and congratulations.

Students of physics should welcome the appearance of an English rendering of Professor Mach's essay on "The Science of Mechanics." As a rule, mechanics has been treated as a branch of mathematics, and the Prague professor opened a new vein of inquiry when he began in an earlier work to regard it as one of the physical sciences. His views have since had development and confirmation from other independent sources, and the sense of his teaching on this matter was set forth for general students in the treatise which he contributed some ten years ago to Brockhaus' "Internationale Wissenschaftliche Bibliothek." It is from the second edition of that work that Mr. McCormack has made his excellent translation. The book, setting forth as it does the elements of its subject with a lucidity, clearness, and force unknown in the mathematical text books, is admirably fitted to serve students as an introduction on historical lines to the principles of mechanical science; and this business-like rendering of the treatise deserves the attention of both teachers and students of this important branch of knowledge. The work is published on this side by the Open Court Publishing Co., Chicago.

The REVIEW desires to acknowledge the courtesy of the *Engineering and Mining Journal*, New York, in kindly forwarding for its use in the present issue the engravings illustrating the exhibits of nickel from the Canadian Copper Co. at the World's Fair, Chicago.

In this number we present our readers with a mass of information, statistical and descriptive, respecting the mica mining industry of Canada. Of interest, too, should prove the data given respecting the properties, operations, output and shipments of the Lake Girard Mica Mining System—probably the largest and best equipped mica producer on the continent. Some idea of the extensive operations of this company may be gathered from the fact that since its organization up to the end of the year ended 31st July last, it has expended in the acquisition of lands and buildings, $97,500, and on machinery and plant equipment, $24,000. 200 persons found employment in and about the mines, and 20 men, 30 boys and 45 girls at the factory. 15 men were also employed in teaming mica and supplies. The distribution of its expenditure on account of wages during the same period was: at the mines, $56,276; in teaming, $6,830; or a total of $63,106, which, together with $20,090 at the factory and $1,875 in management, brings the amount up to $85.071 for a period of 26 months. The shipments of cut mica from September, 1891, to September, 1892, were 55,824, and from September, 1892, to July 1893, 66,140 lbs. Of trimmed mica from September, 1891, to September, 1892, 36,545 lbs.; from September, 1892, to July, 1893, 73,022 lbs. An idea of the capacity of the System's factory can be gathered from the fact that during the months of January and February, 1893, 16,315 lbs. of cut mica and 12,292 lbs. of trimmed mica were prepared for shipment. The average monthly output has been in the neighborhood of 5,000 lbs. of cut, and 6,000 lbs. of trimmed mica, while the stock of mica on hand at date includes some 1,200 tons of merchantable mica and about 250 tons of material for grinding.

By agreement under date of 30th September, Mr. W. R. Elmenhurst, Montreal has transferred and conveyed all his interest in the System to Capt. T. J. Watters, of Ottawa, who carries on the business under the same style and management as before. It is understood that the System will shortly be put before the public in the form of a joint stock enterprise with a view to enlarged capitalisation for more extended working. Until it is ascertained upon what basis the enterprise is to be floated the REVIEW refrains from further comment merely referring those of our readers who may be interested to the facts and data reproduced elsewhere in this issue.

As all our readers know, in consequence of the depression in the fertilizer market the production of Canadian phosphate this season has reached its lowest ebb, the majority of the mines having closed down. But the actual figures may prove of interest, so we quote the shipments from Montreal to Europe during the year as given by Customs Manifests:

By Wilson & Green	2,606 tons
By British Phosphate Co. (Ltd.) ...	1,590 "
By General Phosphate Corporation.	716 "
Total reported at 14th Oct	4,912 "

Several shipments have also been made to the United States, but no returns have been received at date of going to press.

The *Otago Daily Times* of May 8th says:—One of the largest blasts that has taken place in New Zealand with the explosive roburite came off on Friday evening, in the Blue Spur Company's mine, under the supervision of Mr. C. E. Stokes, representative in Australasia for the Roburite Explosives Company, London. The manager, Mr. J. Howard Jackson, had a tunnel driven into the face of the cement 36 feet, from which were two drives measuring each about 30 feet, in the ends of which were deposited 700 lbs. and 300 lbs. of roburite respectively. These charges were detonated with electric fuses connected with the dynamo. The face of the cliff was about 76 feet high, and the surface operated on extended about 150 feet. The manager estimates the cement dislodged by the explosion at 22,500 tons, but a great deal more than this would be the ultimate result gained. On examining the ground above the cliff enormous fissures were found extending back to a distance of nearly 80 feet, and it is expected that when the present dislodged mass is removed fully 25,000 tons more cement will be available without any further blasting. This strongly illustrated the power of this explosive, which is three times more powerful than blasting powder, and disintegrates the cement more efficiently. The cost is said to be about 25 per cent. less. In addition to this, greater safety is claimed for roburite, as it can only be exploded by a powerful detonator. The manager estimates that by this blast a supply for at least three months has been furnished from that portion of the claim.

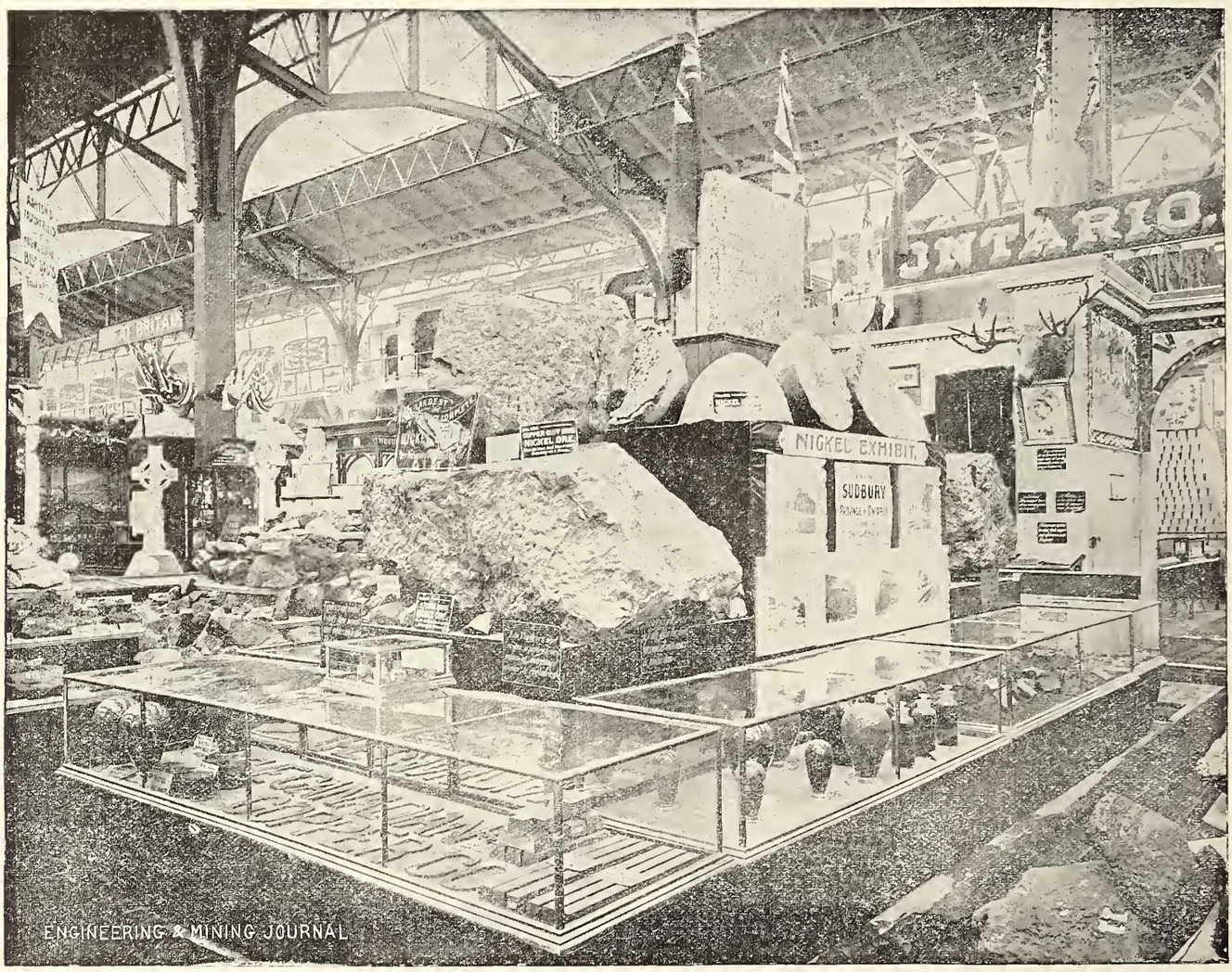
One of the most important instances of the application of water power for electric power transmission in Great Britian at present is that at the Greenside silver-lead mines in Cumberland, which was deisgned by Mr. A. T. Snell about three years ago in conjunction with the mine manager, Mr. Borlase. These mines are among the few that find it possible to compete with foreign mines, and this is the case partly owing to a fine grade of ore which contains a large percentage of silver cheaply extracted by crystallisation, but largely because the use of electricity for winding, hauling and pumping has decreased the cost of working. On the east slopes of Hellvelyn lies a small natural lake called the Red Tarn, and on the north-east the impounded water of Keppel Cove. Between the two waters rises the hill of Catstycam, at the base of which the two overflows join, and near to which the Greenside Silver Lead Mining and Smelting Company have erected their turbine-dynamo station. The water is led from an elevation of 1,750 ft. above sea level, and flows through an open watercourse 1¼ miles in length to a large reservoir, from which it is conveyed down the hillside for a distance of 360 yards in 15 in. cast iron pipes. The fall at the station is equivalent to a vertical head of 400 ft., and the effective horse power is about 200. The generating station contains one of Gilkes & Co's vortex

turbines of 100 horse power, driving a four pole compound dynamo made by the General Electric Power and Traction Company. The house is large enough to duplicate this plant when necessary, and pipes, watercourses, &c., are already laid for this purpose. The electric current is conveyed by two bare copper conductors on poles for six furlongs, to where it enters the mine at an elevation of 1,850 ft. above the sea level. The conductors from this point are insulated, and covered with lead. About three-quarters of a mile in the mine, or one and a-half miles from the dynamo, a 9 horse power series motor is employed to wind ore from a set of sinkers. Further into the mine another quarter of a mile, and down 120 yards at the bottom level, is fixed another 9 horse power motor, working a three-throw pump, forcing the water 360 ft. in height. About midway between these motors there is fixed a dynamotor, which reduces the pressure from 600 to 250 volts for working an electro-locomotive in the lowest day level of the mine, through which runs the water pumped from the 120 yards level and the whole of the water used by two hydraulic winding engines. four horses formerly worked this level. The locomotive runs with twelve wagons, the total weight when loaded being 18 tons, and does the work of the four horses with the greatest ease. The conductors in the level are phosphor bronze wire, and the current is fed to the locomotive by four contact pulleys. The difficulties encountered in fixing this plant and wiring the level can only be appreciated by the practical man. All main stations in the mine are lighted by incandescent lamps in series of six.

Our Mineral Exhibits at the World's Fair.

The display made by Canada at the World's Columbian Exposition, has been one that, on the whole, did her credit in the eyes of the world. Nevertheless, it is to be regretted that the natural and economic products exhibited by the Canadian Geological Survey in the Mines and Mining Building were not shown in a more compact form and to greater advantage, as might very well have been the case. The Geological Survey, the Provinces of Ontario, Quebec, Nova Scotia, New Brunswick and British Columbia, together with the North-West Territories, were all represented within the Fair grounds. Manitoba had an interesting exhibit, but just outside the grounds. Of these—the Geological Survey collections may be described as being systematic and orderly—of a more technical and scientific character than any of the others, as can readily be expected. Yet, with these, there were also displayed an excellent exhibit of economic minerals, among which stood out prominently the very fine trophy of graphite and its manufactured products sent by Mr. W. H. Walker, of Ottawa.

The collection of rock specimens, exhibited by the Geological Survey, in charge of Dr. Selwyn, contained upwards of 1,400 exhibits of rocks from definite localities and formations in Canada —from Labrador and Nova Scotia, on the East, to Vancouver Island, on the West; and from the international boundary line on the South, to the most northerly districts of this continent. Every province and known or explored district was represented.



The Exhibit of the Canadian Copper Company, Sudbury, Ont., at the World's Fair, Chicago.

A notable collection of fossil remains, comprising some 2,400 specimens, illustrating the life history of the various formations in the earth's crust, as it is known in Canada from earliest Cambrian times was also shown. These fossil remains enable the prospector or geologist to tell whether he is above or below the coal line or in the neighbourhood of the petroleum or gas-bearing rocks, etc. It was the most complete collection of fossil remains observed in the Mining Building and was a credit to Canada.

Apart from valuable economic minerals we we have, in Canada, an almost inexhaustible supply of gems, precious stones and semi-precious stones that are an interesting study in themselves.

in the Court assigned to the Geological Survey was a collection of precious stones, most artistically arranged, exhibited by Messrs. C. P. Willimott & Co., Ottawa, that were admired by everyone, and the exhibition of which did much to reveal to strangers, and to many Canadians, too, the great mineral wealth in this line of many localities in the Dominion. Nature's great storehouse holds many secrets of our mineral wealth hidden away from mortal ken. This live firm have pierced the Stygian darkness here and have brought out before us Canadian gems and precious stones that but few ever dreamed were stored away in the bowels of the earth. We need no longer chase over the globe to gather up our ornamental gems and rich stones; we have them right here in Canada, right under our hands. Push and perseverance and scientific knowledge combined, have spread these things out in rich profusion before us. Let us see what they are like.

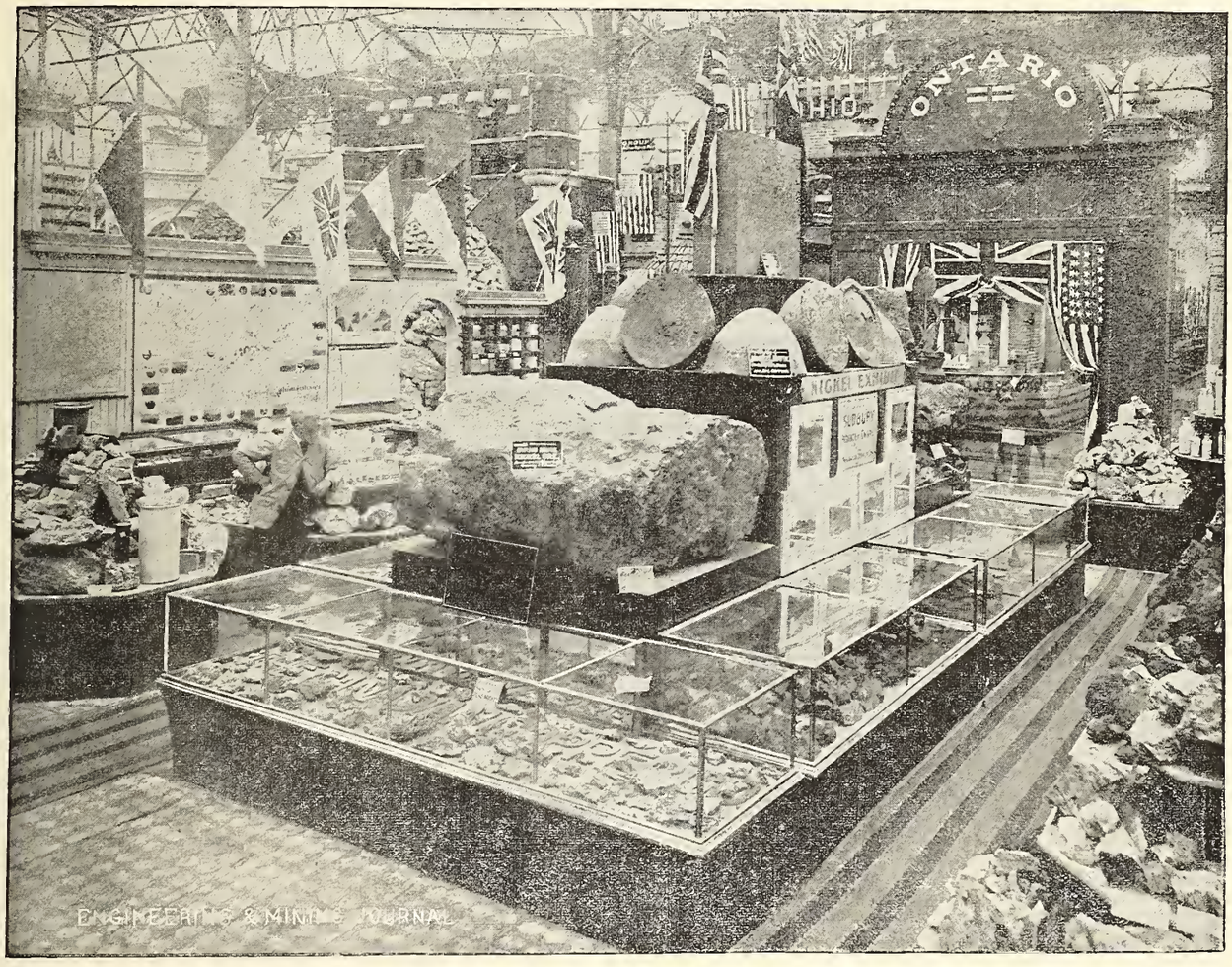
Among the rich specimens to be seen on exhibition were the lovely gems of quartz asteria, jacinths, grossularites and tourmalines. "Oh! what beautiful stones!" the lady visitor daily cried. Here were beautiful dress buttons made from the much prized Amazon stone of Ottawa county; in another case the most perfect dessert knives, with handles of the rich agates from the frowning cliffs of Blomidon, in Nova Scotia. In all shapes and forms of bright polished slabs, appeared such Canadian beauties as agates, jasper, porphyries, peristerites, perthites, aventurines, sodalites, wernerites, Labradorites, etc. Near by were a variety of articles manufactured from these beautiful and precious stones, such as knives, inkstands, stamp and match boxes, pencils, penholders, papercutters, button and glove hooks, tablets, an endless variety of charms, brooches and studs.

Resting among its handsome sister gems was to be seen in the collection, the bright, flashing quartz asteria, with its twinkling, changing, peculiar star—a Canadian gem that is now shining resplendent on more than one crowned head, and that in wealth and luxury sparkles in rivalry beside the not as handsome, even if more costly, diamond. The owners and wearers of this pretty stone say its brilliancy can be equalled by the diamond alone.

One striking feature of our Canadian gems is the variety and beauty of their tints. The grossularites and tourmalines from the County of Ottawa are resplendent in this respect. The former are found in this rich mineral district from colorless varieties to those of a golden yellow, while the tourmalines are of every shade of green and yellow, and have been mistaken for Oriental stones by expert mineralogists. These latter stones could be substituted, according to their shades, for a great number of other well known gems.

From the Renfrew district, Ontario, were the greatly admired jacinths—beautiful gems that Canadian ladies have but to get acquainted with, when they will wear them quite universally.

Semi-precious stones are found in many places in the Dominion, and the collection in the Canadian Section of the Mines and Mining Building, have been admired, studied and most favorably criticised. Renfrew was here again to the front with aventurines that are, indeed, things of beauty and joy forever, with their artistically spangled surfaces, glistening with numerous specks of green, yellow and white. The Labradorites are always admired, while the vivid sheen of the peristerite, with its blue reflected light, makes it in every way superior to the Ceylon moonstone. The azure blue sodalite from Ontario and the distant Rocky Mountains is another beauty, and surpasses the far-famed lapis lazuli, as it is slightly harder, takes a higher polish and is not marred by inclusions of iron pyrites.



The Exhibit of the Canadian Copper Company, Sudbury, Ont., at the World's Fair, Chicago.

The whole of this section was well worth seeing.

Ontario had a strikingly good exhibit. This go-ahead Province certainly did credit to herself. Mr. A. Blue, Director of Mines, Commissioner Awrey, and the able staff, of which Mr. Boyle was a conspicuous figure, have reason to be proud of the result of their months of arduous labor. The Ontario Court presented an attractive front, and the nickel trophy in the centre formed a unique and massive pyramid, impressive to the sight, and never to be forgotten by the passer

by. Iron ores, copper, mica, graphite, zinc, galena, asbestos, building stone, petroleum and its products, fire and brick clays, soapstone and apatite, or phosphate of lime, with its products, were shown in abundance and tastefully and artistically displayed. Due regard to the economic aspect of the exhibits was to be seen on all sides. The gold and silver ores also formed salient features in this Court, whilst salt, marbles, sandstones, granites, clays and cement stones served to complete the exhibits of a province whose mineral wealth is only now just being appreciated. Ontario's display of its mineral wealth was indeed an instructive one. To the economic collection was added a mineralogical one of considerable extent, furnished by a private collector in the person of Mr. W. G. Kidd, of Kingston, Ont. The nickel trophy deserves more than a passing mention. It was undoubtedly the most complete and extensive display of the kind ever made in the world. The exhibit of the only country which could compete with Canada was New Caledonia—a colony of France—and whilst its exhibit was certainly instructive and interesting, yet it was small and inconspicuous. Some of Ontario's specimens of nickel ore weighed 6,000, 8,000 and 12,000 lbs. respectively, and gave a capital idea of the extent and richness of our far-famed nickel deposits. Nickel anodes, nickel shot plates and ingots of nickel were also exhibited.

On a side wall hung a large and most instructive map of Ontario, which gave at a glance the location of the principal mining districts of the province. This province possesses a number of metalliferous belts which will eventually prove more remunerative even than at present anticipated, and with the increased population, an influx of capital, and careful and economic mining, there is no doubt a future bright and hopeful is in store for Ontario mining.

Next to Ontario came Quebec and British Columbia. Both had very attractive exhibits.

British Columbia had a thoroughly systematic and well arranged display, and one could get from the descriptive matter on the labels attached to the exhibits more information than from almost any of the exhibits observed in any of the Courts within the Mining Building. A conspicuous pyramid of gilt bricks, with the figures $53,512,652 being the amount of gold produced by British Columbia in about 30 years time from its placer fields, showed what that province can produce, and promises well when hopes are entertained of equalling some day the output of California, whose display in an adjoining Court shows the ores, placer deposits and other mineral products to be much the same, similar in character, nature and origin. Samples of the gold from Cariboo, Cherry Creek, Okanagan, Yale, Bear River, Antler Creek, California Creek, Mosquito Creek, and from the Ophir mine, Cassiar, and other localities too numerous to mention, were attractively displayed in a handsome and neatly arranged case. Every known mineral district was represented and carefully looked after by the Provincial Commissioner, due prominence being given to the new promising argentiferous galena regions now being opened up.

The Province of Quebec exhibit deserves especial notice, inasmuch as the display (though not comprising all the minerals which the province produces), nevertheless showed clearly and to advantage its industries and mineral products. The magnificent display of mica, second to none in the world, came in for a large share of attention. Quebec had indeed a beautiful exhibit of the different varieties of that useful mineral—muscovite, phlogopite and biotite micas. The Lake Girard and Haycock exhibits were the most conspicuous and formed attractive features.

General View of Canada's Mineral Exhibit at the World's Fair.

Asbestos—naturally—came in for a large share of attention. Canada is well known to "beat the world" in this product. The trophy and glass cases with the numerous and magnificent specimens displayed at once attracted the eyes of all the visitors, a good proportion of whom purchased asbestos souvenirs, which will do much to spread the fame of one of our most remunerative mineral industries.

Phosphate of lime, or apatite, formed an attractive series of pyramids. Canada's apatite deposits are so well known, and especially to Canadians, that a description of the various localities from which they were derived is deemed unnecessary here. One point is certain, that Canada's apatite deposits are rich and of a very high grade, being superior in quality to Carolina or Florida phosphates, and when the present depression in the fertilizer market vanishes, as surely it will in the near future, its production will again assume a leading place in the industries of the country.

The iron and copper ores of Quebec were well exhibited, together with their products. From the historic mines of the St. Maurice Forges to the more recent finds, there was an interesting display. Besides these, were samples of petroleum from Gaspé, a new oil field, which is now attracting special attention; mineral pigments, plumbago, galena and other minerals were so displayed as to form a first-rate commercial exhibit, reflecting the greatest credit upon Commissioner McIntosh and his staff.

Leaving out of consideration a comparatively insignificant gold exhibit from Nova Scotia, the display made by the Maritime Provinces at the Columbian Exposition was certainly not by any means creditable.

In the first place, there were hundreds of small specimens lying helter skelter in glass cases, which ought to have been arranged and properly labelled, or else thrown out as unworthy to represent the products of such an important mineral field.

Nova Scotia, with her coal, gold, iron, gypsum and building stones, might have made a magnificent display. Pyramids of attractive height, laden with such samples of its numerous mines as only this province can show, should have been erected, and the world could have seen at a glance what great wealth she actually possesses.

New Brunswick had one specimen worthy of note, a large block of sandstone, but this, unfortunately, was hidden in a corner out of sight. All told this Court was not what it should have been.

The coals of the North-West were very partially and sparingly represented. Specimens and blocks from the Bow River Pass, from Lethbridge, from Edmonton and Anthracite, were to be seen beside some building stones placed on a table in a corner near the Quebec Court.

On the whole, however, it must be admitted that Canada's exhibit at the World's Fair, whether judged by the excellent display made by the Geological Survey or by those of the various provinces, gave a very comprehensive idea to visitors of her great natural resources and the splendid field they offer for investment.

A.

THE CANADIAN MICA INDUSTRY.

The Occurrence, Production, Exports and Uses of the Mineral, together with a Description of Canadian Mines.

Since the application of mica for electrical purposes, the production of this mineral has assumed during the past two years considerable importance and has attracted, on account of its abundant occurrence in Canada, the attention of mining men and capitalists to the Dominion. The United States, and more especially the State of North Carolina, has largely contributed to the world's supply, but owing it is said, to the comparatively limited character of the workable deposits, the output from this source, as may be seen from a comparison of the last Census returns, has materially diminished. Quoting from Dr. David T. Day's "Mineral Resources of the United States" for 1889 and 1890, being the last statistical volume issued by the United States Geological Survey, we find the returns of cut mica produced in that country from 1880 to 1890 given as follows :—

OUTPUT OF THE UNITED STATES.

Years.	Amount. Lbs.	Value. $.
1890	60.000	75,000
1880	81.669	127,825
1881	100.000	250,000
1882	100.000	250,000
1883	114.000	285,000
1884	147.000	368,525
1885	92.000	161,000
1886	40.000	70,000
1887	70.000	140,250
1888	48.000	70,000
1889	49.000	50,000

Writing of the occurrence of the mineral in the United States, Mr. L. J. Childs, (Eleventh Census of the U. S. 1890) says, "While deposits have been noted in nearly all of the States on the eastern border of the Appalachian mountain system, it is only in New Hampshire and North Carolina that the industry has assumed at any time much importance. In the West the most important deposits are located in the Black Hills, in the neighbourhood of Hartzville, Wyoming, and in the Cribbensville district of New Mexico."

IMPORTS INTO THE UNITED STATES.

The importation of mica into the United States has steadily increased, the sources of supply being Germany, British East Indies, British Australasia, the United Kingdom and Canada, the official returns for a period of ten years ending 31st December, 1890, being as follows :—

1880	(30th June)—	Value....	$12,562
1881	"	"	5,839
1882	"	"	5,175
1883	"	"	9,884
1884	"	"	28,284
1885	"	"	28,685
1886	(31st December)"	....	56,354
1887	"	"	49,085
1888	"	"	57,541
1889	"	"	97,351
1890	"	"	207,375

EARLY KNOWN OCCURRENCES OF MICA DEPOSITS IN CANADA.

Canada has long being known to be rich in the occurrence of economic mica deposits. More than thirty years ago, Sir William Logan, (Geology of Canada, 1863, pp. 494-5, and 795) referred to the deposits of muscovite, then known to exist on Yeo's Island, Cape Tourmente and other sections of the Province of Quebec. Mention is also made of the Phlogopites at Grenville, Que., and in North and South Burgess Ontario, "in all of which," says Sir William, "the mica is obtained in large sheets, which being transparent and free from flaws are wrought and employed for the same purposes as the muscovite or potash varieties." A crystal from Grenville was so large as to furnish sheets measuring twenty-four by fourteen inches. Good mica we are told was found on the tenth lot of the fifth range, and on the first lot of the tenth range of Grenville, as well as farther to the westward in the augmentation of this township. On the 17th lot of the Township of North Burgess, large crystals of magnesian mica were found in abundance in a bed of soft pyroxenic rock. The mica was traced for about 300 feet and considerable quantities were extracted. "It appears" concludes Sir William, "that in this region, and in Grenville, sufficient quantities of mica could be obtained to supply a larger demand." In 1884 an important deposit of muscovite was opened at the Villeneuve mine, in the Township of Villeneuve, Ottawa County, and a considerable quantity has been mined at different times up to the present date. Another early producer was the Sydenham Mica and Mining Co., in the Kingston district.

CANADIAN PRODUCTION OF MICA.

Until the past three years, the production of the mineral in Canada was limited, the out-put being almost wholly consumed by founders for the pannelling of stoves and furnace doors. A certain quantity, however, was ground for lubricants, fireproof paints and cements. Referring to the statistical report issued by the Division of Mines, (Geological Survey of Canada, 1891) we find the following returns —

1886	$29,008
1887	29,816
1888	30,207
1889	28,718
1890	68,074

The discovery of its value as an insulator and the rapid extension of its use in electrical practice, however, has had a marked effect in stimulating the development of the Canadian industry. In 1891 the production had increased in value to $71,510, while in 1892 and in the first six months of the present year the exports as reported to the CANADIAN MINING REVIEW were :—

Port of Ottawa, to the U. S.	$54,729.82
" Brockville, to the U. S.	6,608.44
" Kingston, to the U. S.	11,421.00

Exhibit of the Lake Girard Mica Mining System, given highest award at the World's Fair, Chicago.

" Montreal, to G't. Britain.	$ 615.00	
" " United States	1,473.00	
Total cut mica....		$2,088.00
Port of Montreal, to Great Britain	$ 179.00	
" " United States	4,313.00	
" " Germany....	485.00	
" " Newfoundland	25.00	
Total ground mica....		5,002.00
Total to 31st January, 1892....		$79,849.26

To 31st July, 1893.

Port of Ottawa, to United States	$27,156.82
" Brockville, " (to end of April only)	3,614.53
" Kingston, to United States	19,155.00
" Montreal, to Great Britain and United States	1,792.00
Total from 1st Jan., 1893, to 31st July, 1893,	$51,567.31

COMMERCIAL APPLICATIONS OF MICA.

USE IN ELECTRICAL INSULATION—On account of its superior cleavage, Canadian mica is greatly favored by electricans in the United States, and notwithstanding a duty of 33% *ad valorem*, it has more than held its own against local and foreign products in that market.

"The bulk of the mica used by us," writes the Edison General Electric Co. of New York, "is Canadian mica, which is known in the market as 'amber mica,' being of amber colour and clear. It is essentialthat the mica should be smooth, free from wrinkles and crevices, it must split readily and must be flexible, so much so that a piece of mica .010 in. thick would bend to a curvature of about 3 in. diameter without cracking. Mica that has dark spots or spots similar to rainbow colour, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration. We give you below the principal size of mica used by us, and would say that at the present time we have orders out for some of the sizes ranging from 200 to 600 pounds :—Commutator mica : 1½ x 4 in., 1¼ x 6⅜, 1⅜ x 4¼, 1⅜ x 6½, 1⅜ x 8, 1¾ x 8, 2 x 5, 2½ x 5, 2 x 7, 2 x 12, 2½ x 12, 4 x 4, 5 x 8. Binding mica, 1¼ in. wide."

"The insulating power of mica," says an eminent electrician, is superior to that of any other substance applicable to armatures. An advantage peculiar to itself, is its even laminated structure. The buildersof armatures can split the sheets into any desired and uniform thickness with great ease and accuracy. A valuable property of mica in connection with commutator insulation is its proper degree of hardness,it does not wear away too rapidly under the action of the brushes.

Of all substances mica is probably the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected even by short circuits or bad constructions, will have no injurious affect on mica. Mica thick or thin may be held in a gas flame without burning or melting.

Mica for electrical purposes must be flexible and non-conductive. Color does not matter, but perfect cleavage is of the highest importance, as "electrical mica" must be of uniform thickness, and is often gauged to the thousandth part of an inch. Thesizes and shapes of sheets vary greatly, 450 different patterns having been called for. The price is from 10c. to $2.50 and upwards per lb., and varies with the size of sheet and difficulty of cutting the pattern.

MICANITE—One of the most recent uses to which mica is commercially applied is in the manufacture of micanite, by which large quantities of scrap or inferior qualities are utilized, and by means of a patented process, small pieces of waste mica are built up into sheets 40 inches square and larger if necessary. The product can also be made in any desired form and is largely supplied to the electrical trade for insulating purposes.

PAINTS, WALL PAPER AND ORNAMENTAL USES—Another use for mica is its application, when previously colored or metalized, to ornamental purposes. From its unalterable nature the material preserves gilding, silvering or coloring from deterioration; and from its diaphanity, the articles so treated will preserve all their brilliancy. Finely ground mica, or colored gelatin, also shows handsome effects, and when mixed with a solution of gumarabic, it makes a good silver ink. The gelatin combination is used for inlaying buttons. Another beautiful application of mica is in the production of bronze-like colors, which bear the names brocades, crystal colors and mica bronzes. Among the advantages of these are that they are indifferent to sulphurous exhalations, are very light in weight, and in some colors are even more brilliant than the metal bronzes. When small particles of mica silver are spread over articles coated with asphalt varnish, the result is a good imitation of granite. The crystal colors are also suitable for calico printing; and fabrics to which they are applied surpass in brilliancy the heavy bronze and glass dust fancy fabrics of Lyons. Such colors have been used to decorate procelain and glassware, the articles undergoing a second heating up to the fusing point of their glazing. By suitable dyes, the material is colored to a variety of hues.

MICA FOR GLASSES AND SPECTACLES—The best employment of the immense quantities of scraps and fragments of waste mica which suggests itself as worthy of a wider field than it now possesses is the substitution of mica for glass in spectacles worn by workmen, especially stone and metal workers, to protect their eyes from chips and splinters. As already made in Germany, these mica glasses are concaved in the shape of watch glasses, and are about one twenty-fifth of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined: Mica spectacles cannot be broken. Pounding with a sledge hammer merely flattens them, nor does molten metal poured on the mica affect it. The shower of pointed iron particles which issues from lathes merely rebounds from the elastic mica glasses.

AS A LUBRICANT—The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes its value lies in the fact that it is absolutely anti-friction, and it is claimed with its use hot boxes or journals are simply impossbile.

OTHER USES—Mica has been used on board war ves-

View of a portion of Surface Works at Lake Girard Mica Mines, Township of Wakefield, Que.

sels, in localities where glass would be broken by the concussion due to the firing of heavy guns. It is made into reflectors, sea compasses, inlaying for wood instead of enamel. It is also employed for roofing purposes, and in several patented processes forms a water and fireproof covering for strata of rubber, tar, canvas, felt, and similar materials. Its most recent application in a powdered state, is to the so-called wax-printed cloths as shown at the World's Fair Chicago. These cloths are made by applying melted wax to the cloth with a stick in free hand designs, and before the wax is dry powdered mica is sifted over it. The effect is said to be remarkably rich.

GROUND MICA—In recent years the preparation of ground mica has become an industry of itself, and several United States' firms have gone into the business. Waste or scrap mica is generally used. The difficulties of grinding are great, owing to the tough and scaley nature of the material. Mills which work well on almost everything alse fail utterly on mica. Recently there has been a return to old-fashioned burr-stones, though most of the manufacturers keep their process a secret. The grinding is usually wet. Some manufacturers grind mica to a very fine powder for "specialties," but the sizes of ground mica usually made are 24, 40, 60, 70, 80, 100, 140, 160, and 200 meshes to the inch, and the prices range from 5c. to 10c. per pound. Scrap mica for grinding is bought for about $12 per ton at the mine. It must be free from rust or specks, which would affect the color and lustre of the product.

PREPARATION FOR MARKET—Care is taken in mining to avoid drilling through the mica crystals, or to break them unduly. The mica thrown down by blasting undergoes a preliminary hand-dressing underground. It is then taken to the "mica shop," where it is split with knives into sheets of the required thinness, and afterward sheared into sizes. The workman has on his bench a stationary pair of shears and a large number of blocks or templates of the sizes to be cut. An experienced mica-cutter can tell at a glance the largest size which can be cut from a given piece of split mica; he selects the proper template, holds it on the mica, and shears the four sides, using each edge of the block as a straight-edge. Each size sheared is set away by itself. The sheets are sheared by further scaling, if necessary, and finally packed in paper in pound packages. At the factory of the Lake Gerard Mica Mining System in Ottawa this hand labor is greatly reduced and a great saving effected by the use of patented cutting machines operated by electricity. These are described more fully in our description of the factory. The production of merchantable sheets is usually from 4 to 5 per cent. of the block mica brought from the mine, and may run as high as 8 or 10 per cent.

CANADIAN WHITE MICA LOCATIONS.

With regard to the occurrence of mica in nature, we have to distinguish in general two varieties, of commercial value: those which are essentially silicates of alumina and alkalies, chiefly potash, often with lithia and fluorine, including muscovite and lepidolite; and the magnesian micas, phlogopite and biotite; the former generally belonging to granitic rocks, and the latter to limestones.

Among the principal localities where muscovite mica has been found to occur, are:—

(1) The Villeneuve mine, lots 30 and 31, Township of Villeneuve, Ottawa County, Que., where it is found frequently associated with tourmaline, and occurs abundantly in crystals in a coarse pegmatite vein.

(2) Alumette Lake, at Montgomery, Renfrew County, Ontario, where large plates and crystals occur, in a vein of graphitic granite.

(3) Yeo's Island, on the Upper St. Maurice River, Portneuf County, Quebec, in association with black tourmaline and inclusions of white sub-transparent quartz.

(4) Lac Pied des Monts, about six miles from Murray Bay, Quebec.

(5) Escoumaine mine, 25 miles from Tadousac, Que.

(6) Lot 8, range VII, Township of Masham, Ottawa County, Que.

(7) Lot 4, range XI, of Township of Muller, Frontenac County, Ontario.

THE VILLENEUVE MINE.

Prominent among these locations is the Villeneuve mine, the pioneer producer of the country. The first operations date back to 1884, when it was first opened by Mr. W. A. Allan, Ottawa, by whom it was transferred to the British and Canadian Mica and Mining Company, who in turn, after working it successfully for some time, passed it into the hands of Mr. S. P. Franchot, of Buckingham, the present owner.

With slight interruption the mine has been operated up to date. From 1884 to 1888, about 35,000 lbs. of cut mica was reported as having been taken out, the product being of fine quality, clear and free from spots, realized good prices. Since then it has been worked for mica and feldspar, shipments of the latter product being made to England and the States, where it is utilized in the manufacture of porcelain and potteryware. Of the output of mica from the mine since 1888, no figures are at hand.

The Villeneuve muscovite occurs chiefly in crystals between the contact of pegmatite and gneissic rock and yields for the most part flat sheets without wrinkles or crevices; the vein is said to have a width of 400′ in N.E. direction. Black and red tourmaline is frequently met with and the laminaes show frequently red or black spots of this material.

Large quantities of this mica have been shipped to England and Austria. The mine is equipped with a steam and air compressor plant and a suitable working force is employed.

THE HAYES MINE, MURRAY BAY.

Recent development work in the Lac Pied des Monts mine, Murray Bay, owned by Mr. F. B. Hayes, Ottawa, has given very satisfactory results; large crystals up to 2 ft. in diameter have been obtained. The mica is of remarkably fine quality. The single laminaes show frequently the occurrence of tourmaline of black, red and green color, a great quantity, however, yields clear sheets. Three tons of large sized black mica has been taken out inside two and a half months. Large quantities of this mica are to be shipped this month to Germany.

THE OCCURRENCE OF AMBER MICA.

Concerning the second variety, the phlogopite or amber mica, its occurrence is very common among the Laurentian limestones, sometimes in more or less abundantly disseminated small scales or crystals of pure limestone and dolomite. The colors of these crystals are generally some shade of yellow or brown; but in rare cases they are of a deep olive green or silver white. "At the Calumet Falls," (Geology of Canada, 1863), "delicate olive green prisms of phlogopite, sometimes an inch in diameter and several inches in length, are found imbedded with crystals of pyroxene in a pink lamellar limestone. In Burgess, Ontario, large tables of a steel-grey mica, with a somewhat metallic lustre, are found in a similar limestone with crystallized apatite, a prism of which was in one case found imbedded in a crystal of mica." The largest specimens of phlogopite are generally found in beds near to bands of quartzite or pyroxene gneiss, which often limit the crystalline limestones, or are interstratified with them. The mica occurs in large tabular crystals with pyroxene and calcite and often with quartz, orthoclase and rarer minerals. The principal areas where these phlogopite deposits have been found in Canada are in the Provinces of Quebec and Ontario, and more especially in the counties of Ottawa, Pertha nd North Burgess.

The often expressed opinion that the mica deposits were of superficial character or were downward to a limited depth, has been fully disproved by the great development work carried on by the largest Canadian mica company, "The Lake Girard Mica System." It has been proved by the operations of this company that the de-

View of Lake Girard Mica Mine, looking from Lake.

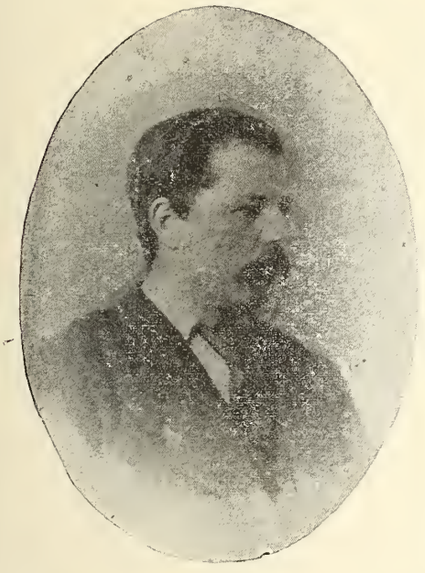
posits though frequently interrupted by dead ground, continue to the depth and are for the greater part in connection with each other by chains of small sized mica crystals, by fissures filled with mica matter or by bands of soft reddish limestone. In following this theory valuable discoveries have been made in considerable depth.

CANADIAN AMBER MICA LOCATIONS.

Some idea of the extensive occurrence of amber mica in Canada may be gathered from a reference to the following localities where it has been found :—

Lot 1, Range II., of the Augmentation of Grenville, Argenteuil County, Que.
Lot 9, Range VI., of Grenville, Argenteuil County, Que.
Lot 17, Range VII., " " "
" 1, " V., " " "
" 19, " VIII., of Portland, Ottawa County, Que.
" 10, " X., of Templeton, "
" 9, " XI., " "
" 10, " V., of Hull, "
" 9, " XII., " "
" 13, " XV., " "
" 1, " IV., Masham, "
Aylwin, Ottawa County, Que.
Lot 22, Range II., Cawood.
South Burgess, Leeds County, Ont.
Lot 6, Range VIII., North Burgess, Ont.

Needless to say, not all are workable deposits, nor do all of them warrant the necessary expenditure for mining. In many cases we find small and limited deposits containing contorted and twisted mica, yielding only a very small percentage of cut sheets. Very promising properties, however, have been discovered in great number in the



Mr. C. C. Symons, Mine Captain, Lake Girard Mine.

district of Wakefield, Templeton, and on the Lievres River. Among the many localities which have been worked with success are :—

(1) Lot 15, in the 11th Range of Templeton, owned by the Templeton and North Ottawa Mining Co. There were on the surface two veinlike deposits with small contorted crystals at a distance of about 10 ft., the walls being parallel in width from two to four feet ; these were tested by a shaft, and in a depth of 15 ft. the two bodies came together forming a single vein of eight feet wide and crossing the whole size of the shaft.

This vein continued most regularly and in about 25 ft. depth a large phosphate body was struck, the vein split up and the crystals were distributed over the whole body. They were large sized and most regular in their structure, yielding a large amount of flat sheets. The output with a small force of men for two and a-half months working (including all preliminary work), is reported to be sixty barrels or nearly 20,000 lbs. of selected mica ; about 90 tons of phosphate of lime of 84% were also taken out.

It will be easily seen from these returns that this mine has been worked with very satisfactory results.

(2) Lot 15, Range 8, in the Township of Templeton owned formerly by Mr. A. W. Stevenson, C.A., Montreal, in about two months work yielded considerable quantities of large sized crystals and a good output of phosphate of lime. Exact figures regarding output are not to hand. The principal opening is situated on a mountain ridge, and consists of an open cut of 20 ft. wide, 25 ft. long, and 30 ft. deep, and shows on the walls and in the bottom large sized crystals with well defined sheets. One crystal taken out weighed 300 lbs. and cut 12 x 8 inches square.

This mine has been examined by experts and is considered to be one of the richest mica and phosphate mines in that district ; it is to be regretted that operations had to be suspended last year owing to ligitation as to title. It may here be stated that since the commencement of pending litigation, the rights of Mr. Stevenson have been purchased and are now possessed by Capt. Thomas J. Watters, the owner of the Lake Girard Mica System.

(3) Lot 17, in Range 8, Templeton, operated by Mr. J. Wallingford, has been worked for four months. The principal opening consists of an excavation 15 ft. wide, 25 ft. long, and 28 ft. deep. A vein of 8 ft. wide containing well defined mica crystals an crosses the shaft in east and west direction, showing large sized pockets and aggregates of mica in pyroxenic rock, frequently intermixed with apatite. 41 tons of selected mica have been taken out with an average number of eight men, and shipped to Boston to a large electrical concern. Five men have been steadily employed in cutting sheets.*

(4) Lot 15, in the 8th Range, west part Templeton, owned by Judge Dugas, Montreal. There are three openings on the mountain ridge which runs across the property. The largest excavation shows a vein-like occurrence of mica ; crystals of about 40 in. long, and 3 ft. wide have been taken out. This vein has been followed by a shaft to a depth of 12 ft., and has yielded a large quantity of well defined mica crystals. The three openings have been worked for nearly two months, and operations have been suspended on account of the lack of machinery. The output during that time was 80 barrels of 350 lbs. each or 28,000 lbs. of black mica. 5,500 lbs. run of mine were also cut and yielded :—

50 lbs.,	4 x 6 in.	and larger	.....	$ 75.00
125 "	3 x 5	" "	.....	187.50
1,500 "	2 x 3	" "	.....	150.00
				$412.50

Capt. T. J. Watters, Ottawa, Owner Lake Girard Mica Mining System.

The largest and most notable producer of Canadian mica, however, is :—

THE LAKE GIRARD MICA MINING SYSTEM

organized in the latter end of 1891, and which at date owns and operates an area of 3,210 acres of mica land in the provinces of Ontario and Quebec. The disposition of this large property is as follows :

PROVINCE OF ONTARIO.

Name of Mine.	*Township.*	*Acreage.*
Martha	North Burgess	100
Pike Lake	"	200

PROVINCE OF QUEBEC.

Alice	Hull	100
Bradley	"	200
Cassidy	"	300
Charette	Templeton	200
Foley	Hull	200
Lake Girard	Wakefield	210
Murphy, P.	Templeton	100
Murphy, B. J.	"	200
Nellie & Blanche	Hull, Villeneuve, Templeton, Wells	1000
Prudhomme	Hull	80
Stevenson	Templeton	200
Snapshot	Hull	20
White mica	Portland west	100

* The prices obtained last month for trimmed mica sheets 1-16 in. thick were :—

For a ton,	5 x 8	inches	$400
"	4 x 6	"	275
"	3 x 5	"	150
"	2 x 3	"	60

The promoter and leading spirit of the Lake Girard Mica Mining System is Captain Thos. J. Watters, Assistant Commissioner of Customs, Ottawa, to whose energy and capacity more than to any other is due not only the position of the System as one of the largest producers of mica in the world, but also the development of the mica trade into an important Canadian industry. This gentleman is reported to have spent during the past two years, not less than a quarter of a million dollars in acquiring lands, erecting buildings and machinery and in the outlay necessary to place the system on a working basis. Mr. Don C. Watters conducts the business at the offices of the System on Besserer street, Ottawa, where also the cutting and dressing establishment of the system is located. A brief description of the occurrence of the mineral on some of the more prominent properties operated by the System and the methods of mining and treating the product may not be out of place. Our information is gathered mainly from the official reports of Mr. F. Cirkel, M.E., who has just completed an examination of the mines, from data furnished us by the System, and from a personal inspection by a representative of the REVIEW. Our engravings are reduced from Mr. Cirkel's drawings and photographs kindly furnished us by the System.

It is perfectly safe to say that the mine which has proved to be the most profitable source of its supply has been

THE LAKE GIRARD MICA MINE

situated on the 2nd range of the Township of Wakefield, county of Ottawa, Que. This mine is connected by good roads with Wakefield station on the line of the new Gatineau Valley Railway and is distant from the works at Ottawa about 22 miles. Mining has been carried on in the southern portion of the property on the border of

Mr. Don C. Watters, Ottawa, Manager Lake Girard Mica Mining System.

Lake Girard. The country is hilly and covered for the greater portion with good hardwood suitable for building, burning and mining purposes.

System of Working—The principal work at the mine has been done on shaft No. 1. Mr. Cirkel in his report says :—

"Shaft No. 1, which has been sunk at an incline of from 73 to 75 degrees in a chain of large sized mica deposits, measures near the surface 15 to 20 feet square, and widens gradually out at a depth of about 120 feet until it reaches the dimensions of 25 to 30 feet square in the 165 feet level. At a depth of 90 feet, or 6 feet above lake level, a drift marked E (map 2) of a size of from 8 to 15 feet square has been made in the western continuation of the mica deposits found in the shaft. At this level a test hole in the south wall of the shaft has shown four feet rock and eight feet mica, and to reach this apparently large deposit a cross-cut in southern direction, (marked A), has been put in operation. At the time of my visit this cross-cut was 28 feet long and its head-wall showed small pockets of reddish limestone with small mica crystals.

"Above the 165 feet level, where the shaft is widening out considerably, extensive deposits have been worked out, the continuation of which could be followed by drifting to the west in 133 feet length.

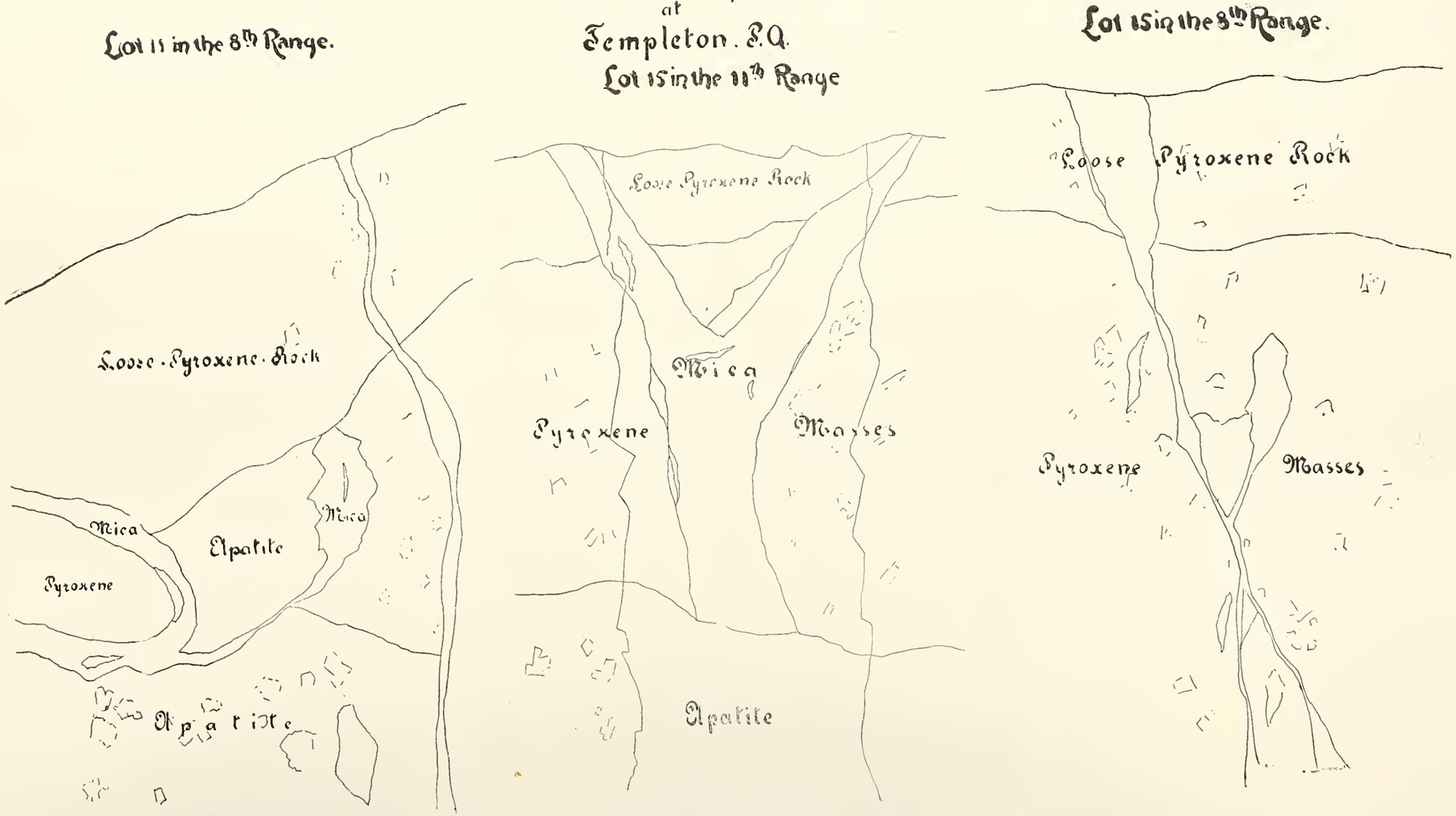
"By a southern cross-cut B, at a distance of 14 feet from the shaft and in a height of 10 feet, a deposit of crystals measuring 9 feet in width in the bottom has been laid bare ; these contain throughout crystals of a well defined character imbedded in reddish limestone measuring from ½ a foot up to 1¼ feet in diameter. It is the intention to work this deposit, which will continue according to its outline to the depth, from the 165 feet level by the southern cross-cut marked C.

"Drift G, to the east on the same level, shows in the bottom in 12½ feet distance from the shaft an aggregate of mica crystals, measuring in the end of the drift 8 feet in width ; the large sized crystals occasionally show

CANADIAN MICA INDUSTRY.

Reproduced from the Drawings of Mr. F. Cirkel, M. E.

Mica-Deposits at Templeton, P.Q.



Property of the Templeton Asbestos Mining Co. Ltd.

Property of The Templeton & North Ottawa Mining Co. Ltd.

Property owned by Mr. A. W. Stevenson, C A., Montreal.

cracks in the laminaes, but not of sufficient importance to prevent them from yielding a large quantity of commercial mica sheets.

"The horizontal southern continuation of the mica deposits in the 165 feet level led to the necessity of sinking a second slope at a distance of 25 feet from the first shaft; this slope is at present 45 feet deep, and has an incline of 75 degrees. Two drifts (marked D and A) in different levels, to the south and to the east have led to the discovery of valuable mica deposits. Drift H, to the east showed at the time of my visit, in the bottom, head-wall and roof, crystals measuring in size from half a foot up to 1¾ feet in diameter, imbedded in a soft reddish limestone frequently intermixed with large crystals of pyroxene. Drusy cavities have been met with very frequently and the crystals obtained therefrom are characterized by their sharpness of outline; these crystals were for the most part complete in their structure, yield laminaes of 3 inches up to 8 inches square, being mostly free from wrinkles and crevices. The deposits measured in the bottom of the drift 8 feet in width and 12 feet long; large sized crystals were also irregularly distributed over the limestone in the head-wall and especially on the roof, so that this deposit may likely prove to be a continuation of the deposit in drift G of the 165 feet level."

In a supplementary report, under date of 13th August last, written after a later examination, Mr. Cirkel writes:—

"In a height of 25 feet from the bottom of the pit, a drift marked D, 8 feet high and 10 feet wide has laid bare extensive pockets of reddish limestone, one of which contained an aggregation of crystals in size from 6 to 8 inches in diameter; this deposit measured at the time of my visit 8 feet in width.

"Taking all the observations with regard to this vein together, I have to state that according to my experience, this deposit is the most extensive which has ever been discovered in the Laurentian system, and with such great results on hand, I only can repeat that the Lake Girard shaft at the present day is, and will be, the richest and largest producing mica mine so far known on the American continent."

Operations in Shaft and Equipment—The points of operation are at present cross-cut A in the 90 feet level, cross-cut C in the 165 feet level, drift H and cross-cut D in the 45 foot slope. Three 3-inch Ingersoll rock drills supplied with compressed air, are at work during day and night. The rock is hoisted from the bottom of the 45 foot shaft to the 165 foot level by buckets which empty by means of a dumping car into another bucket which goes through the upper shaft to the pit's mouth. This double handling of the bulk of material requires a lot of labor and is expensive but this will soon be overcome as a cut from the bottom of the 45 foot shaft through the north wall to the 165 feet level is being made so as to hoist in one way to the pit's mouth. Here the rock will be removed by a large car to the dumping ground on the east side of the shaft.

On account of the generally safe walls the shaft is timbered only near the surface, but is fitted with six safety platforms at an average distance of 25 feet from each other, and connected by inclined ladders. Drainage is provided for by two 3-inch pumps, worked by compressed air, in 118 and 165 feet levels respectively; the pumps are in use only temporarily as the quantity of water in the bottom of the shaft is very small. The shaft is equipped throughout on all platforms and working points by electric light supplied by a 100 lamp dynamo.

Buildings—This mine is equipped with excellent accommodation for a large working force, while the various buildings necessary for the operations consisting of engine and shaft houses, blacksmith's and carpenter's shops, cobbing sheds, stables, office and dwelling houses are strongly built and admirably suited for their requirements. It is noteworthy that each and all are supplied with the electric light.

Working Plant—This comprises two boilers of 38 and 54 h.p. respectively, and two 55 h.p. respectively; one seven drill and one three drill, Ingersoll compressor and equipment; one double cylinder hoisting engine (Copeland & Bacon), and one double hoist 18" x 30"; Worthington and other pumps (three in number); Kay dynamo for 100 Edison lamps; derricks, etc.

Handling and Transportation—The mica as it comes from the pit is weighed and delivered to the dressing shed on the west side of the shaft where it is separated in different sizes; it is then carried by a car automatically handled on an incline track to the foot of the hill where the loads are taken up by waggons and transported to the cutting and dressing works at Ottawa. *En route* a stop is made at the very commodious stables owned by the system at the village of Cantley (see photo). Here the waggons usually meet those coming from Ottawa with supplies for the mines and the loads are transposed the horses from the mines returning to Lake Girard with the lighter loads and the mica going on with the Ottawa teams to the city.

Output from Lake Girard—The following table shows the output during six months in 1892 and during three months in 1893, according to statements kindly furnished by the manager of the System:—

(N.B.—The months of November and December, 1892, and January, 1893, are not included on account of a boiler explosion, during months of the May and June, 1893, an interruption of the regular operations was caused by some repairs to the air compressor plant.)

Month.	Output in Tons of 2000 lbs.	Number of Shifts.	Average Daily Output	Average No. of Shifts daily.
1892.				
May....	81·935	1206·5	3·1317	48
June....	91·1322	738	3·1285	29
July....	85·1160	798	3·846	31·8
August...	116·1976	791	4·1311	31
Sept....	106·479	946	4·499	37·8
October.	66·1029	890	2·1321	35·6
1893.				
February.	117·1114	1150	4·1404	40
March...	122·886	1836	4·1755	53
April....	82·186	1177	3·567	47

Average output daily in six months, $3\cdot\frac{1429}{2000}$ tons. Average number of shifts daily in 6 months, 35·5. Average output daily in 3 months, $4\cdot\frac{843}{2000}$ tons. Average number of shifts daily in 3 months, 48·6.

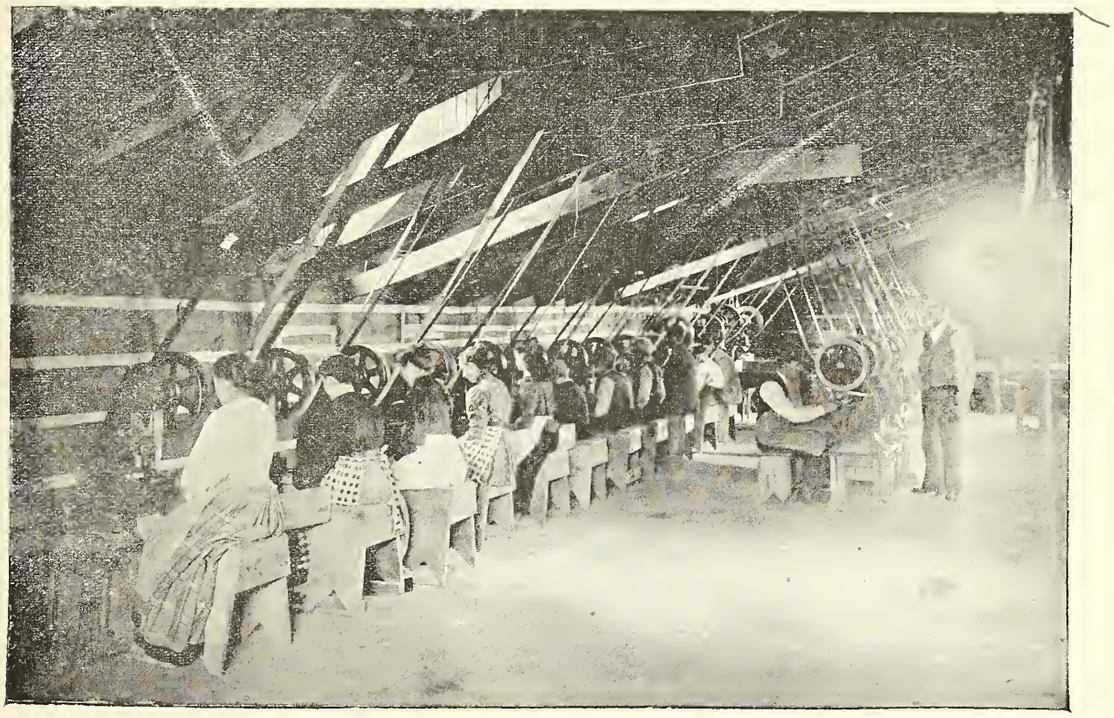
For the above 9 months the average daily output was, therefore, $3\frac{1840}{2000}$ tons.

The Richness of the Lake Girard Deposit—In concluding his report on this property, Mr. Cirkel, after reviewing the work done on the various openings, remarks:

"Taking all observations with regard to the occurrence of mica deposits together in comparison with all the other mica mines working in the Laurentain I must state that the pyroxenic belt of the Lake Girard mine is the richest mica bearing belt at the present day so far discovered in the Laurentain system.

As already stated the average daily output amounted to close upon four tons with an average number of shifts 39·8; it is evident that in consideration of the number of workable deposits as described above this output can be largely increased when the difficulties caused by double handling of the material in the 165 ft. level and by the limited capacity of the present machinery plant has been overcome; without increasing the number of men the shaft should give, after an installation of the new plant, not less than five tons merchantable mica daily.

As a result of my examination I have no hesitation in saying the Lake Girard mica mine, according to the present prospects and with regard to the proved richness of the pyroxene belt on mica deposits, is at present and will be the largest producing mica mine so far known in the mica industry of the American continent."



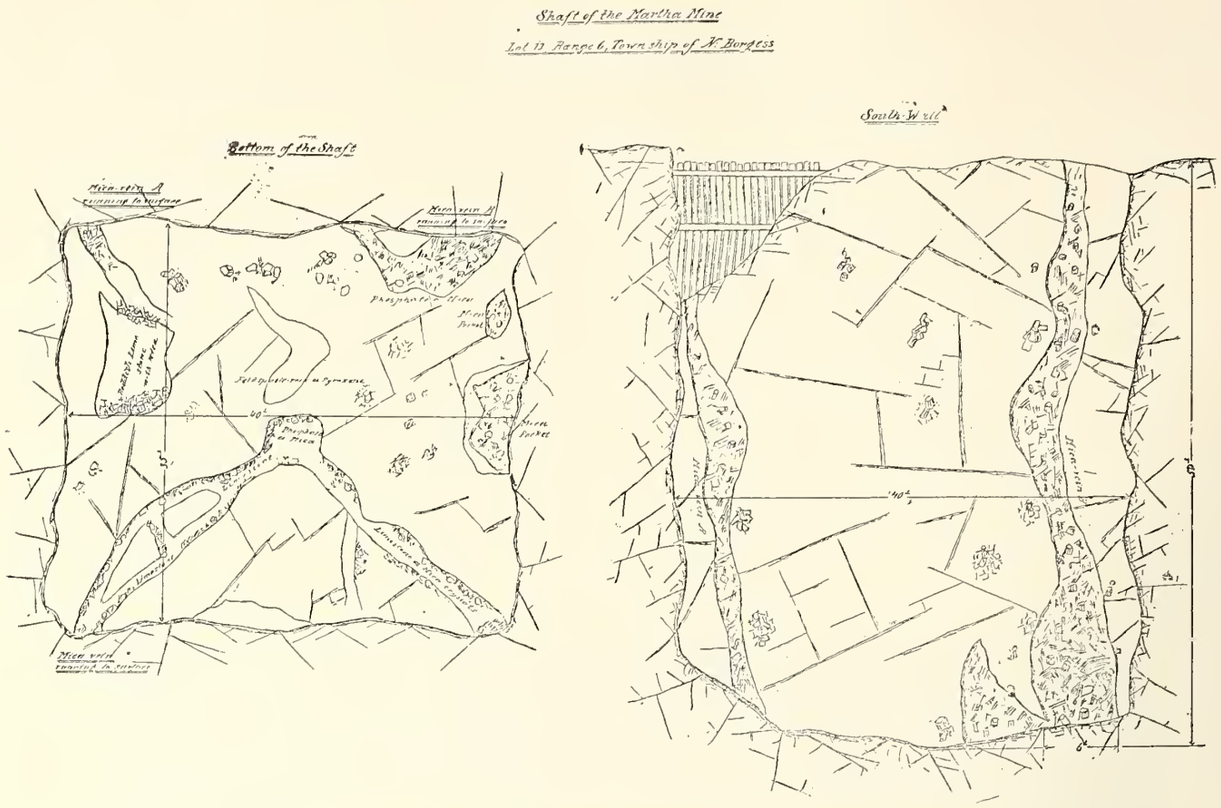
Interior of Cutting and Dressing Works of the Lake Girard Mica System, Ottawa.

"Drift H to the east has been continued for a length of 58 feet from the shaft middle and in a width expanding from 16 feet to 22 feet near the head-wall. The expected results, as described in my last report, with regard to the continuation of the deposit have greatly surpassed my expectations, not only is the vein continuing in regular width, but the quality and largeness of the crystals is improving the farther work is prosecuted to the east. Numerous crystals from half a foot up to 3 feet in diameter are distributed over the bottom head-wall and the roof. They are of very well defined characters, do not contain wrinkles or crevices, and yield a large quantity of commercial sheets. One crystal partly lying in the solid rock measured 2 feet 10 x 1 foot 6, one of the largest crystals of mica of good quality which has ever been found in the mining district of Ottawa. The vein has in the middle of the drift a width of eight feet and is split up near the head-wall in to two branches, each measuring six feet in width; the whole vein exposed shows a length of 34 feet.

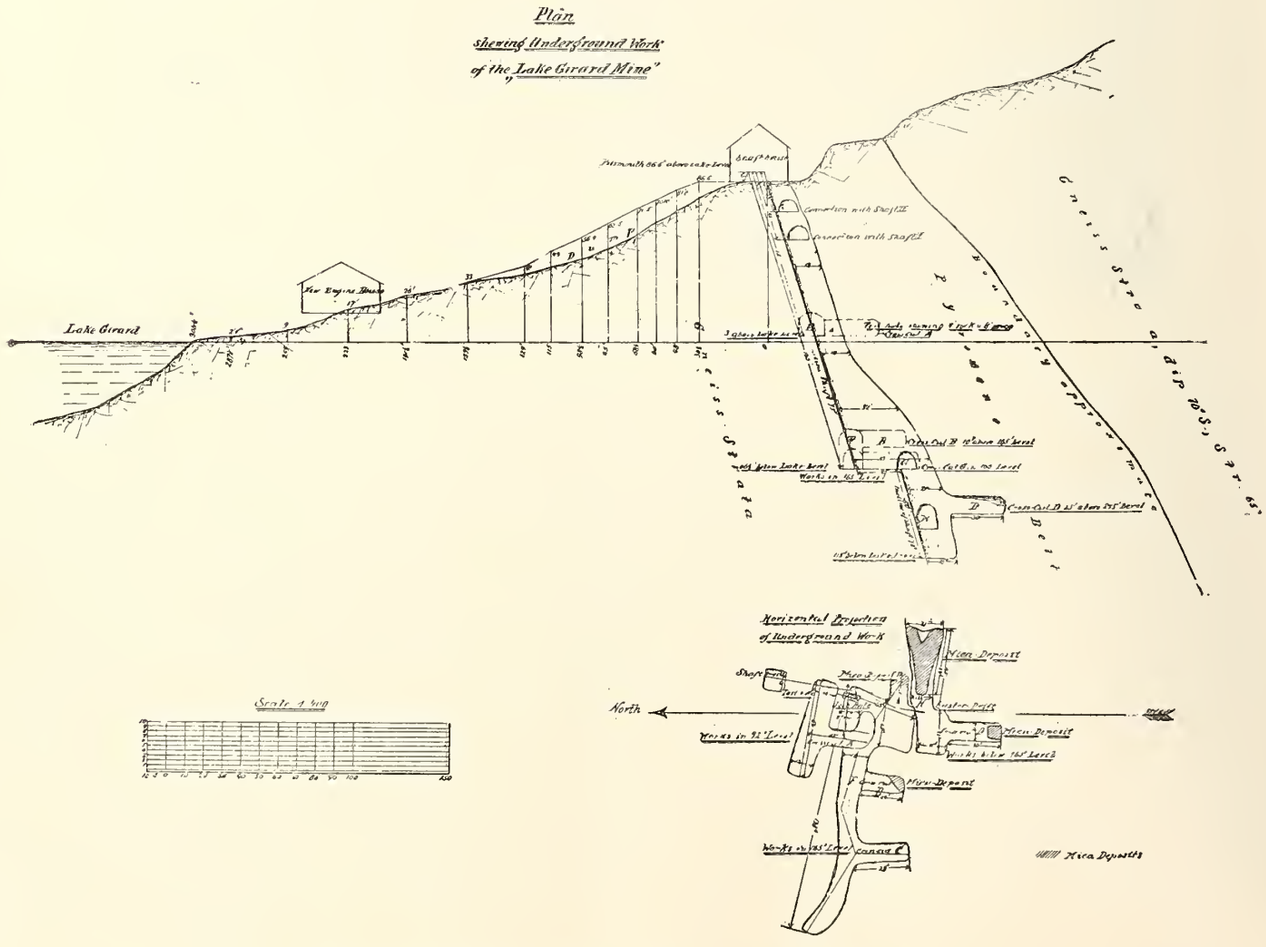
"There is no doubt that taking into consideration the length of this vein, the great distribution of crystals on the roof and in the bottom, the abundance of limestone as an essential companion of mica, that this deposit is a true fissure vein and is undoubtedly identical with the deposit discovered 40 feet higher in drift G of the 165 ft. level, thus giving the total dimensions of this vein to be 34 ft. long, 40 ft. high, and 8 ft. wide. Based on these measurements—not counting the extension of the deposit to the depth and to the east—the estimated quantity that can be raised very readily is 325 tons of large sized mica sheets. Beyond doubt this deposit will continue to the east and to the depth, and according to all appearances, the largest extension of the vein is not yet apparent.

CUTTING AND DRESSING FACTORY.

This commodious structure is located at 504 to 520 Besserer street, Ottawa. There are at present in use at the Lake Girard Mica System's factory twenty-three power presses for cutting irregular shaped discs and segments. These power presses are all of American manufacture; twenty of them from the E. W. Bliss Co., Ltd., of Brooklyn, N.Y., two of them are made by the Ferracute Machine Co., of Bridgeton, N.J., and the other manufactured by the Long and Allstatter Co., of Hamilton, Ohio. Eighteen of the Bliss machines are the well known Bench presses and specially suitable for cutting patterns most in demand at the present time. The dies used in this factory are the most



Plan VI.—Showing Occurrence of Mica in the Main Shaft of the Martha Mine, North Burgess.



Plan I.—Showing Underground Work at Lake Girard Mine.

complete at present in use for this purpose, and include some sixteen different patterns ranging in size from 5¼ x 10″ to ⅞ x 3″, and with a few exceptions are all made in Ottawa. The electric current used is supplied by the Chaudiere Electric Light and Power Co., of Ottawa. From this motor a dynamo is run which supplies light for the entire premises.

In addition to the cutting presses already mentioned, there are in use ten cutting shears for two-siding and cutting material of unusually large size.

During the past year there have been on an average of 70 men and women employed in this factory; the women's work is divided into three departments, viz :— Punching at the press, scribing mica for the shears, and cleaning and packing material for shipment. The other departments, in which the men are employed, is the splitting and culling when received from the mines, and cutting with shears.

From figures of the quantities shipped from the factory, supplied by the courtesy of the management, we gather the following :—

CUT MICA.

From September, 1891, to September, 1892, 55,824 lbs. ; from September, 1892, to July, 1893, 66,140 lbs.

TRIMMED MICA.

From September, 1891, to September, 1892, 36,545 lbs. ; from September, 1892, to July, 1893, 73,022 lbs.

An idea of the capacity of this factory can be gathered from the fact that during the months of January and February, 1893, 16,315 lbs. of cut mica and 12,292 lbs. of trimmed mica were prepared for shipment. The average monthly output has been in the neighborhood of 5,000 lbs. of cut, and 6,000 lbs. of trimmed mica, while the stock of mica on hand at date includes some 1,200 tons of merchantable mica and about 250 tons of material for grinding.

Stables at Ottawa—One of the most completely equipped stables in Ottawa is that belonging to the Lake Girard Mica System. This stable is situated on the same property as the Ottawa factory and storehouse, and is 85 feet long and 40 feet wide, with accommodation for forty horses. It is lighted by electricity from the dynamo in the factory, and is most complete in every respect.

THE MARTHA MINE.

Another property on which the Lake Girard Mica Mining System has done considerable work during the present season is the Martha mine, situated on lot 13, in the 6th range of North Burgess, County of Perth, Ontario. In the north portion of the property extensive mining work was carried on for about six months in shaft sinking, prospecting and general development work. The results obtained were satisfactory. The mica has proved of good merchantable value, and the indications point to a large production when the steam and air plant contemplated by the system has been put in. It is noteworthy that in the production of mica at this mine several hundred tons of apatite of high quality was raised, and this will undoubtedly form a valuable source of revenue when the present temporary depression in the phosphate business has passed away. The mine is equipped with suitable accommodation for a good working force, but the plant equipment is only of a preliminary character.

THE PIKE LAKE MINE.

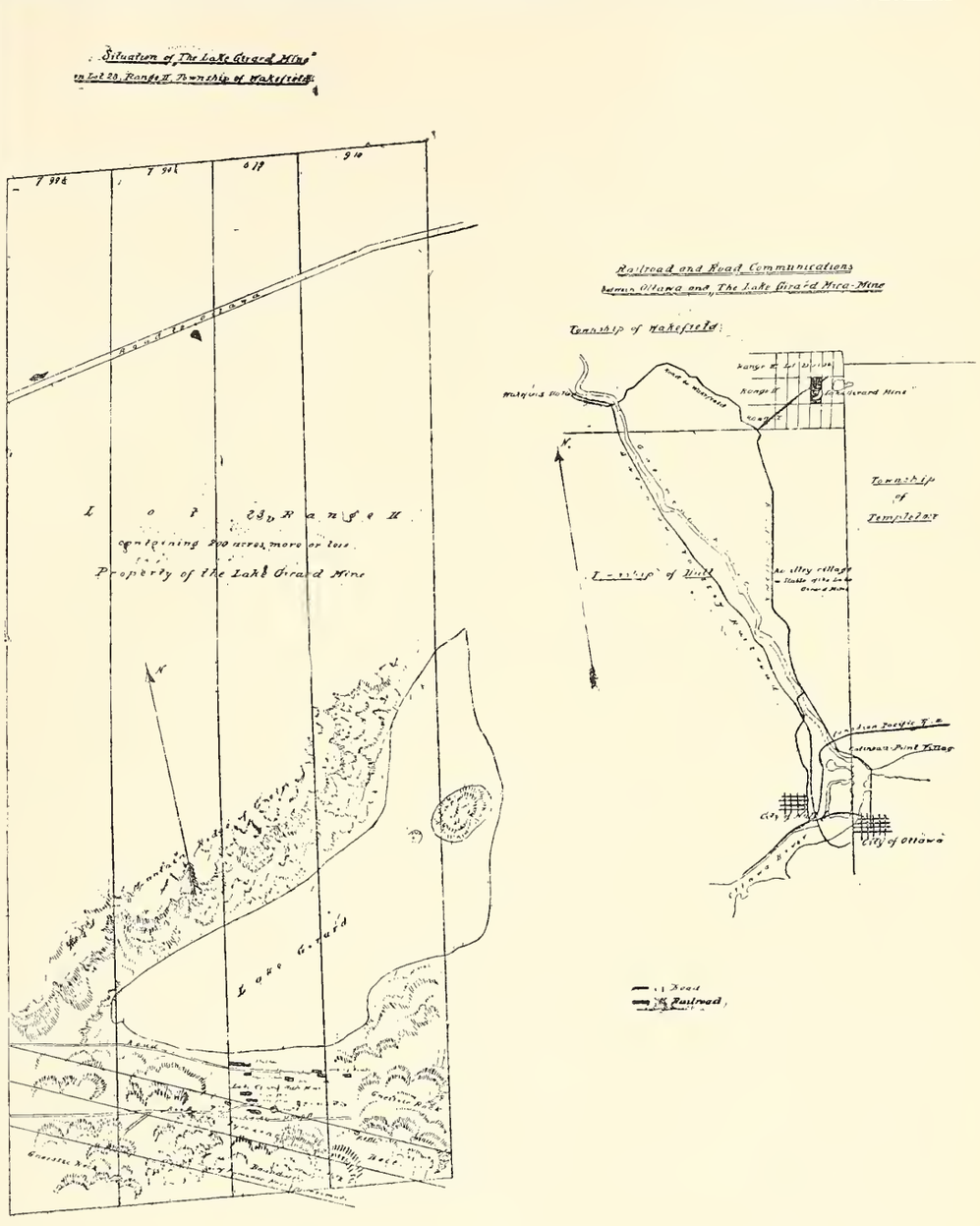
This is situated on the south half of Lots 16 and 17, in the 9th Range, township of North Burgess, county of Perth, and is about eight miles distant from Perth station on the main line of the Canadian Pacific Railway.

The most extensive opening is the shaft marked A on plan IV, which has a vertical depth of 65 feet. At a depth of 30 feet two parallel veins, at a distance of 8 feet from each other run across the shaft under an incline of 30 degrees, being apparently fissures filled with mica matter and crystals. The upper vein, having an average width of two feet, goes off into two small branch veins in the middle, and expands near the bottom of the shaft to a width of six feet. The latter shows crystals of silver mica in sizes of one foot six inches imbedded in pyroxene and pyroxene gneiss, and yielding a large quantity of well defined laminaes of commercial value. "According to all appearances," says Mr. Cirkel, "the vein expands in width considerably in the bottom of the drift, and will undoubtedly join in deeper levels with vein No. 2."

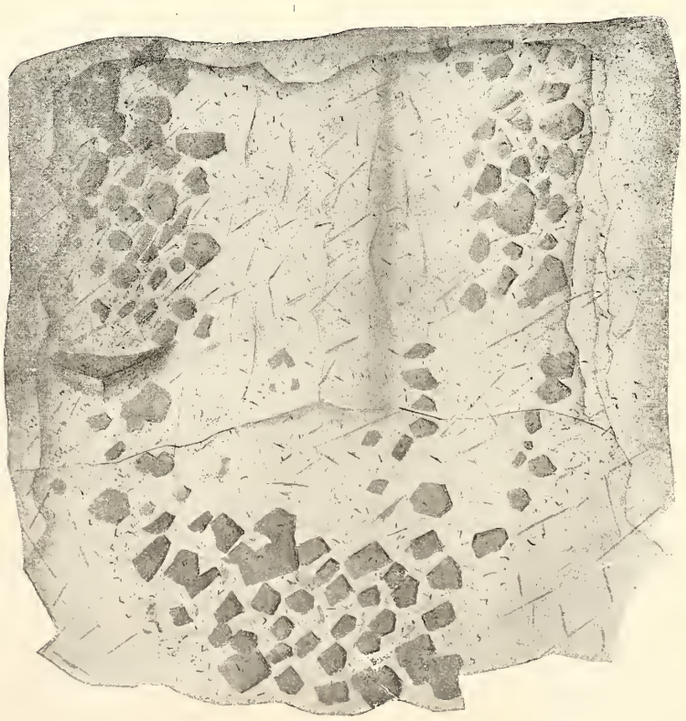
Vein No. 2 has an average width of one and a half feet, widens out in the middle to a pocket of irregular shape and shows near and in the bottom of the drift, crystals of well defined character. Besides these two veins several large sized pockets have been uncovered in drift "D" and many crystals distributed over the bottom indicate the presence of aggregates or pockets of mica in deeper levels. Small pockets have also been worked in the two drifts marked "A" and "B."

The bottom of the shaft and drift "C" could not be examined on account of being partially filled with water.

With regard to the prospects for this shaft they seem to me to be very good. Numerous mica crystals are to be found in the dump of the shaft as a sign for the richness of mica deposits; not less than about 50 tons of commercial mica have been won by cobbing over the dump. This fact, and the presence of two fissure veins and mica pockets in the south wall of the shaft, the great distribution of crystals over the bottom of the drift "D" gives, it seems to me, sufficient evidence for a richness of mica; and had the work of development been carried on, especially in drift "D" to the depth, the same amount of work would have furnished more data for above expressed opinion; but even as it is, it issufficient to show that this part of the pyroxenic belt is rich in mica deposits, and leads to the strong belief that other deposits will occur in the horizontal as well as in the depth. It may, therefore, be safely said that the average output of mica will be of considerable extent and value if the present slow and hand-power plant is replaced by a regular machinery plant of such capacity as to meet all difficulties caused by following the deposits to the depth. It is difficult to estimate the output in future, because no exact data as to the previous work in the shaft are to hand; but compared with other mica mines, and taking into consideration the large quantity of mica already taken out, and the mode of occurrence of the deposits, there should be no difficulty in raising by means of a plant of full capacity not less than one and a half to two tons daily.



Plan III.—Showing Location of Lake Girard Mica Mine.



Aggregation of Mica Crystals in Drift H, Lake Girard Shaft, from a Drawing by Mr. F. Circkel, M. E.

The Choice of Coarse and Fine Crushing Machinery and Processes of Ore Treatment.

By A. G. Charleton.*

Part III—The Cyanide Process.

The plant required for the MacArthur-Forrest process consists of crushers (stamps or rolls) to pulverize the ore to 20 to 60 mesh, and leaching and precipitating tanks of much the same description as those used for chlorination; but as its professed object is the treatment of the ore in bulk, the number of tanks, etc., required for this method of treatment are of necessity much larger than in chlorination works. The cost of erection of such a plant on a basis of treating 50 tons per day, would not, so it is said, ordinarily exceed £6,250, everything included.

The report of Mr. J. R. Bradshaw (assayer, etc., of Charters Towers), states, without going into details, that from information he received at Ravenswood, North Queensland, it can be worked there to profit at a cost of £2 per ton, but the cost must of necessity depend on the district and surrounding circumstances.

Mr. Bradshaw claims, moreover, economy for the process in regard to time occupied in treatment, as compared with raw amalgamation in pans, stating that with an ordinary wheeler, ½ ton of auriferous stone of about 2½ ounce grade is decomposed in 6 hours, representing the capacity of one wheeler as being equal to treating 12 tons per week. Mr. McIntyre, the company's manager at Ravenswood, he goes on to state, is erecting two wheeler pans, measurfng 5 feet in diameter, capable of carrying a charge of 3 tons of ore each, and it will thus be seen that with two pans, 24 tons of ore can be decomposed in 24 hours.

It would be interesting to learn how those arithmetical calculations panned out in actual practice as regards power consumed and other details.

A test of the Ravenswood ore made by Mr. Bradshaw gave an extraction of 89 per cent. of the gold and 70 per cent. of the silver.

If the success of the process demanded the mechanical incorporation of the cyanide solution with the ore in pans, it would seem likely to be foredoomed to failure, and on this account the idea is now almost entirely abandoned.

It would probably be found that, for convenience and speed, barrels could be advantageously substituted for pans, but modern developments of the process have done away with the original notion of auxiliary agitation.

The Chemistry of the Cyanide Process.

This has been ably dealt with by Messrs. Charles Butters, Ph.D., and J. E. Clennel, B. Sc., in a series of papers which appeared in the New York *Mining Journal*, in October last, from which the following extracts are taken:—

Elsner has shown that the very finely divided gold obtained by precipitating a solution of the chloride with ferrous sulphate may be dissolved by potassium cyanide, provided there is an excess of oxygen present.

The compound formed may be looked upon as a double cyanide of gold and potassium ($KCyAuCy$), and the reaction which takes place may therefore probably be represented by the following equation:—

$$2Au + 4KCy + O + H_2O = 2KAuCy_2 + 2KHO.$$

Two interesting points are indicated by the above equation, which it is well to bear in mind, in applying potassium cyanide as a good solvent on a commercial scale:—

1. That the quantity of cyanide theoretically capable of dissolving a given amount of gold is infinitesimal, compared with the weight actually required in practice. Taking Au = 196·8, K = 39·04, and Cy = 25·98, it will be observed that 130·04 parts by weight of potassium cyanide should be capable of dissolving 196·8 parts of gold, or approximately two parts of the cyanide salt should dissolve three parts of gold. The minimum actual consumption in treating free-milling ore, assaying, let us say, 10 dwts. per ton, is about 3 lbs. per ounce of gold recovered, or roughly, forty parts by weight of cyanide for one part of gold. In the leaching-tanks alone 1 lb. of cyanide is generally consumed per ton of material treated.

2. That an extremely small quantity of surplus oxygen is sufficient to cause the solution of the gold, 15·96 parts being required for 393·6 parts of gold, or say as 1 : 25. The air present in a porous mass of tailings, with that dissolved in the water used in making up the solution, is in fact more than ample to effect the reaction. To explain the enormous excessive consumption of cyanide, we must bear in mind the great instability of the simple cyanides.

Hydrocyanic acid is liberated from its salts by all mineral acids, carbonic acid, and all common organic acids. Atmospheric carbonic acid is sufficient to set up a certain amount of decomposition, in which a constant evolution of hydrocyanic acid takes place as follows:—

$$2KCy + CO_2 + H_2O = 2HCy + K_2CO_3.$$

Then, again, we must consider the proneness to oxidation which the cyanates exhibit, and which in fact lies at the base of most of their technical applications. Potassium cyanide readily changes into cyanate and ultimately into carbonate:—

$$KCN + O = KCNO;$$
$$2KCNO + 3.0 = K_2CO_3 + CO_2 + N_2.$$

The presence of alkalies, which always occur in commercial cyanide, tends to induce the peculiar and little understood decomposition termed hydrolysis, which seems to be mostly produced in the zinc boxes by the presence of that metal.

In the reaction alluded to above, the alkali appears to determine a chemical change, in which water plays a part, while the alkali itself is not in the least affected.

There are good grounds for supposing that in dilute solutions a dissociation of the cyanide takes place, so that what we term a weak solution of potassium cyanide is in reality a mixed solution of potassium hydrate and hydrocyanic acid:—

$$H_2O + KCy = HCy + KHO.$$

This being the case it is only natural that hydrocyanic acid should be constantly given off from all vessels in which weak cyanide solutions are freely exposed to the air, and its smell is, in fact, generally noticeable in the neighbourhood of the tanks in which it is stored.

The consumption of the reagent is on these grounds evidently enhanced by the agitation or circulation systems, since these methods involve a constant exposure of fresh surfaces.

Another source of waste is due to the tendency of the simple cyanides to form double salts with each other, or with other metallic compounds.

Salts of iron, and to a lesser extent of aluminium, magnesium, calcium, and the alkali metals are liable to occur in the tailings, especially after long exposure to atmospheric influences.

It seems, therefore, that under the most favourable circumstances an enormous waste of cyanide must take place, which may partly, however, be mitigated by the use of closed tanks and careful attention to the purity both of the cyanide itself and the water employed to dissolve it.

Action of Cyanide on Pyritic Material—Various additional decompositions take place, when cyanide is applied to the treatment of pyritic ores or tailings. The surface ores of the celebrated banket formation of South Africa consists almost exclusively of silica and oxide of iron, the silica occurring in the form of rounded pebbles, embedded in a softer matrix highly charged with ferric oxide, which gives it a characteristic reddish tinge. The gold* is found in this matrix associated with the oxide of iron, or sometimes in small scales on the surface of the pebbles. The pebbles themselves carry little or none.

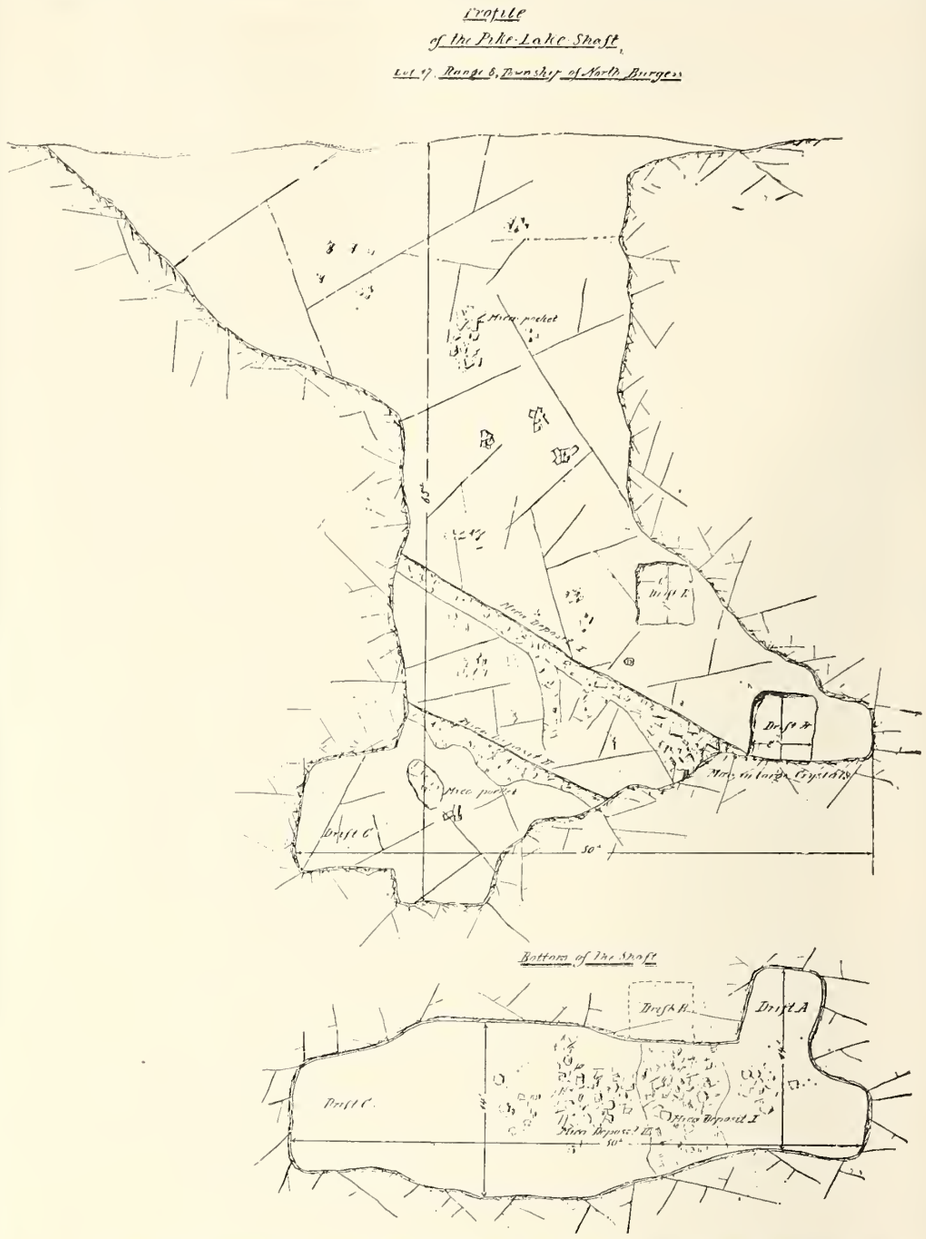
At a lower level this free-milling banket passes into an ore precisely similar in structure, but much harder, and containing the iron in the form of sulphide instead of oxide, which gives it a peculiar bluish tint.

There can be no doubt that the free-milling ores have been formed by the gradual oxidation of the pyrites through the influence of air and moisture during a long period of time, and in fact we see this change in progress, wherever pyritic material has been exposed to the action of the atmosphere. The first effect observed is the conversion of ferric sulphide into a soluble sulphate, free sulphuric acid being liberated. By the action of the air again on the ferrous sulphate, certain insoluble basic sulphates of variable and somewhat complex composition are found to result, whilst a certain amount of soluble ferric sulphate is likely to be produced at the same time.

The pyritic ores or the Witwatersrandt contain also small amounts of copper, arsenic, and sometimes cobalt and nickel, but the amount of these foreign metals has hitherto been so small that it has not practically interfered with the process.

As the fact has been observed, however, at the Robinson chlorination works, that copper and arsenic seem to occur in gradually increasing quantities with the increasing depths of the mines from which these concentrates were purchased, it is possible that these elements may be a serious source of trouble in the future.

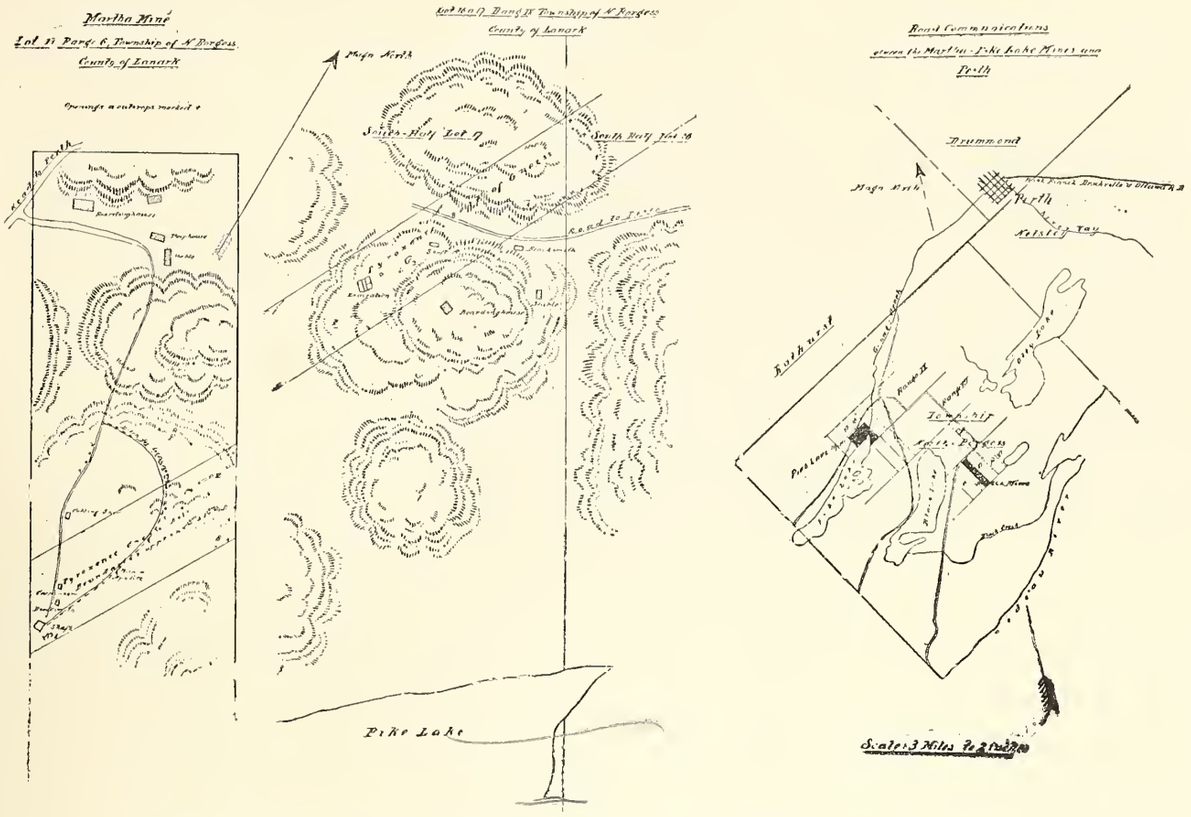
If one attempts to treat a charge partially oxidized pyritic tailings directly with cyanide solution, the free



Plan VII.—Profile of Main Shaft at Pike Lake Mica Mine, North Burgess, Ont.

*Transactions of Fed. Inst. of M. and M. E.

* Taking into account the production from tailings and concentrates the average yield of the Witwatersrandt ore was 12 dwts. 5 grains per ton in 1891 and 12 dwts. 13 grains in 1892. At the end of 1891 there were 1,540 stamps in operation, which yielded 11·23 dwts. per ton by direct amalgamation, whilst the average of free-gold saved fell in 1892 to 9·87 dwts., 2,035 stamps being in operation at the close of the year; the total yield having increased rather than fallen off goes to show that though the ore with depth has become more sulphuretted, it has so far been successfully treated.



Plan V.—Showing location of Martha and Pike Lake Mica Mines, North Burgess, Ont. (from drawings by Mr. F. Cirkel, M. E.)

sulphuric acid present which renders the moisture they contain distinctly acid, sets free hydrocyanic acid. Ferrous sulphate (green vitriol) reacts upon the cyanide with the formation of ferrous cyanide, a yellowish-red flocculent precipitate :—

$$FeSO_4 + 2KCy = FeCy_2 + K_2SO_4.$$

This, however, under ordinary circumstances is slowly converted into potassium ferrocyanide by the excess of cyanide present :—

$$FeCy_2 + 4KCy = K_4FeCy_6.$$

If sufficient acid be present, the ferrocyanide reacts on an additional quantity of the ferrous salt, ultimately giving rise to a blue precipitate or coloration (Prussian blue) :—

$$3K_4FeCy_6 + 6FeSO_4 + 3O = Fe_2O_3 + 6K_2SO_4 + Fe_7Cy_{18}$$

A coloration of that sort on the surface of the tailings or in the solution is therefore a sure indication that acid iron salts are present, and that a large waste of cyanide is taking place.

Ferric salts, when present unmixed with any ferrous compounds, decompose the cyanide solution with evolution of hydrocyanic acid, and precipitation of ferric hydrate :—

$$Fe_2(SO_4)_3 + 6KCy + 6H_2O = Fe_2(OH)_6 + 6HCy + 3K_2SO_4.$$

This reaction takes place in two stages, the first being the formation of a soluble but very unstable ferric cyanide, giving a dark brown solution :—

$$Fe_2(SO_4)_3 + 6KCy = Fe_2Cy_6 + 3K_2SO_4,$$

which decomposes as follows :—

$$Fe_2Cy_6 + 6H_2O = Fe_2(OH)_6 + 6HCy.$$

This gives rise to ferric hydrate part of which, being in a finely divided colloidal condition, is with difficulty removed, as it chokes the pores of the filters.

A mixture of ferrous and ferric sulphates, such as is probably always present in partially oxidized pyritic tailings, causes the appearance of a blue colour on the addition of cyanide, after the free alkali of the commercial product has been neutralized, Prussian blue (ferric-ferrocyanide), $Fe_4(FeCy_6)_3$, being produced when the ferric salt is in excess, and Turnbull's blue (ferrous-ferricyanide), $Fe_3(FeCy_6)_2$, when the ferrous salt predominates.

Before attempting to treat pyritic material or products with cyanide, it is neccssary therefore to get rid of the free sulphuric acid and soluble iron compounds. This is generally done by leaching with water until the liquid running off the tanks no longer shows a coloration with ammonium sulphide. After this treatment the insoluble basic sulphates which still remain, and being gradually decomposed by water, would act upon the cyanide solution, are dealt with by washing with caustic soda or lime water. This converts the basic salts into ferric hydrate and sodium or calcium sulphates. When the quantity of free acid and iron salts is small, the preliminary wash-water may be advantageously omitted.

Lime in the dry state is sometimes mixed with the tailings before the cyanide treatment commences. When this method is adopted the iron is precipitated as a mixture of ferrous and ferric hydrates. After the washing with alkali is completed, the tanks are allowed to drain, and strong cyanide solution of about 6 per cent. is pumped on.

Even after this treatment the consumption of cyanide with moderately pyritic tailings, which have been partially decomposed by exposure, is found to be four times that which occurs with free-milling material.

The presence of a large excess of alkali in the solution brings about various secondary reactions, which lead to a loss of cyanide, such as the hydrolysis before referred to, and a peculiar action in the zinc box mentioned later.

Lime though slower in its action is preferable to caustic soda as a neutralizing agent, as it is equally effective in decomposing the iron salts, less active in producing secondary reactions on the cyanide, and also less energetic in attacking the zinc in the precipitating-boxes.

Ferric hydrate does not appear to be acted upon by potassium cyanide, but ferrous hydrate, which is formed on the neutralization of the iron salts by alkalies, reacts on the cyanide in excess, with the formation of ferrocyanide of potassium :—

$$Fe(OH)_2 + 6KCy = K_4FeCy_6 + 2KOH.$$

Deposition of Gold from Cyanide Solutions.—Under certain conditions, such as the absence of sufficient oxygen in the solution, a partial precipitation of the previously dissolved gold appears to occur. If by any chance the solution should become acid, there is a decomposition of the double cyanide of gold and potassium, in which the gold is generally supposed to be thrown down as (insoluble) aurous cyanide :—

$$KAuCy_2 + HCl = KCl + HCy + AuCy.$$

In working on the circulation-and-transfer system it is found that where pyritic material is under treatment it is not safe to transfer a solution already rich in gold to a fresh lot of tailings, as the extensive decomposition of the solution which takes place may lead to a final loss of gold.

Selective Action of Cyanide.—It is claimed by the inventors of the MacArthur-Forrest process, that in a mixture containing metallic gold, silver, copper, and base metals, cyanide of potassium exerts a selective action, dissolving first the gold, then the silver, and afterwards attacking the copper and baser metals.

The process, however, does not appear to have been successfully applied to ores, such as are met with in parts of California and Australia, containing considerable quantities or foreign metals.

Ores containing sulphides of silver and copper produce considerable decomposition of cyanide, the copper being partially dissolved as subsulpho-cyanide, the silver, however, remaining unattacked.

In two experiments carried out by Mr. Wm. Bettel, chief chemist of the Robinson Gold Mining Company, on an ore from the Albert silver mine (containing 30 ounces of silver per ton and 10 per cent. of copper), it was found that no extraction of silver occurred, this metal being present as sulphide.

Action of the Zinc Shavings on the Solution.—We must now consider the action of the zinc on the gold cyanide solution. Theoretically, a simple substitution of zinc for gold occurs in accordance with the following equation :—

$$2KAuCy_2 + Zn = K_2ZnCy_4 + 2Au.$$

Taking Zn = 65·1, Au = 196·8, it follows that 65·1 parts by weight of zinc should be sufficient to precipitate 393·6 parts of gold, or 1 lb. of zinc should precipitate 6 lbs of gold. The actual consumption of zinc is about 1 lb. per troy ounce of gold recovered. It is evident, then, that zinc is consumed in some other way than in mere replacement of gold.

During the passage of the solution through the zinc boxes a constant vigorous evolution of small bubbles may be noticed, which are found to consist chiefly of hydrogen. The outflowing liquid is found to possess a greater degree of alkalinity than it had on entering at the head of the box, and a smell of hydrocyanic acid and sometimes of ammonia is constantly observed in the neighbourhood of the boxes.

It is clear, then, that a decomposition of the potassium cyanide solution itself by the zinc is in progress, and this is not to be wondered at when we consider the powerful electro-chemical effect which must be produced by the contact of such a highly positive metal as zinc with a strongly negative metal such as gold.

Ordinary commercial zinc loses weight when immersed for some time in cyanide solution, but the action is slow. It is doubtful whether pure potassium cyanide would have any action at all on chemically pure zinc. It is well known that the copper-zinc couple produced by immersing zinc in a solution of a copper salt decomposes water.

An analogous reaction of the zinc couple accounts for the evolution of hydrogen above-mentioned :—

$$Zn + 2H_2O = 2H + Zn(OH)_2.$$

The hydrate of zinc is at once dissolved in the excess of cyanide :—

$$Zn(OH)_2 + 4KCy = K_2ZnCy_4 + 2KOH,$$

which reaction accounts for the increased alkalinity of the solution.

There are reasons for believing that the black deposits formed on the zinc shavings is an actual chemical compound of gold and zinc, which acts as the negative element in the electric couple, the undecomposed zinc forming the positive element.

When strong solutions of caustic soda have been used for neutralizing the acid salts of the ore, a white deposit is frequently observed on the zinc. The alkali first attacks the metal to form a zinc-sodium oxide :—

$$Zn + 2NaHO = Zn(ONa)_2 + 2H.$$

This then reacts on the double cyanide of zinc and potassium always present in the solution, and precipitates the white insoluble simple cyanide of zinc :—

Cantley Stables of the Lake Girard Mica Mining System.

$$2H_2O + Zn(ONa)_2 + K_2ZnCy_4 = 2ZnCy_2 + 2NaOH + 2KOH.$$

This reaction is of some importance as affording one means by which the excessive accumulation of zinc in the solutions is avoided.

Affinity of Zinc for Cyanogen.—Potassium auro-cyanide ($KAuCy_2$) appears to be one of the most stable of the salts of gold, and the reaction in the zinc boxes, shows that the affinity of zinc, together with potassium, for cyanogen, is greater than that of gold with potassium for the same radicle. Hence a solution of potassium cyanide cannot dissolve gold which is in contact with zinc, neither can gold replace zinc in a solution of the double cyanide of zinc and potassium. So long as any zinc is present, therefore, we need not fear that the precipitated gold will redissolve in the excess of potassium cyanide flowing through the boxes.

It is evident also that the cyanogen contained in the double cyanide of zinc and potassium is not available for dissolving gold, nor when a solution charged with zinc is employed in the treatment of a fresh lot of tailings it is only effective in so far as it contains a certain quantity of simple cyanide of potassium or other alkaline cyanide.

New Methods of Precipitation.—The cyanides of sodium and ammonium and those of the alkaline earths (calcium, barium, etc.) will dissolve gold as well as potassium cyanide. Sodium cyanide is more difficult to manufacture than the potassium compound, but a given weight of it should be more effective than the same weight of potassium cyanide, inasmuch as 49 parts of the former are equivalent to 65 of the latter.

The advantages of Molloy's process and others which employ sodium or potassium amalgam will be referred to later. The alkali metal is obtained by the electrolysis of the carbonate between electrodes of lead and mercury :—

$$Na_2CO_3 = Na_2 + CO_2 + O.$$

The sodium forms an amalgam with the mercury. Sodium amalgam may also be manufactured direct from its elements. It is claimed for this method of precipitation that the whole of the cyanogen is restored to a condition available for dissolving gold as shown by the reaction :—

$$Na + KAuCy_2 = Au + KCy + NaCy.$$

Composition of the Zinc Slimes.—Any base metals which happen to be in solution in the cyanide liquor are liable to be precipitated by the zinc along with the gold. Hence the zinc slimes are found to contain a certain percentage of copper as well as traces of arsenic and antimony. Moreover, any impurities in the zinc will also find their way into the slimes, as zinc will be dissolved by the cyanide in preference to any less oxidizable metals, *e.g.*, tin and lead. Silver is dissolved by the cyanide and re-precipitated by zinc by a set of reactions precisely analogous to those of gold :—

$$2Ag + 4KCy + O + H_2O = 2KAgCy_2 + 2KOH, \text{ and}$$
$$2KAgCy_2 + Zn = K_2ZnCy_4 + 2Ag.$$

It has been observed that the proportion of silver to gold is greater in the cyanide bullion than in the gold from the batteries, and this is explained by supposing that the loss of silver in amalgamation is greater than that of gold.

Treatment of the Zinc Slimes.—The removal of the zinc is a troublesome operation, and is only very partially carried out in smelting the dried slimes. The admixture of sand is made for the purpose of forming a fusible silicate of zinc.

A portion of the zinc is volatilized and burns at the mouth of the crucible with a greenish flame, producing the white oxide (ZnO), which is found encrusting the flues, and no doubt carries with it no inconsiderable quantity of gold and silver. The most promising method of treating these slimes appears to be that suggested by Mr. Bettel of fluxing with acid sulphate of soda and fluorspar.

Attempts to remove the zinc prior to smelting have been only partially successful, as all such methods involve the filtration of a slimy mass, which retains soluble salts with great tenacity.

The slags from the fusion of the zinc slimes contain a considerable amount of gold, some of which is in the form of round shot, and may be removed by pounding up the slag, passing through a course sieve, and panning off. The residue from the first fusion should always be fused again with additional lead to form an alloy with the gold. The same lead bars may be used for a number of successive fusions of the slag, and when sufficiently enriched the gold can be recovered by cupellation.

Testing of Cyanide Solutions.—It is a matter of importance to determine exactly what strength of cyanide solution is used in treatment of tailings. The ordinary method of testing depends on the fact that silver cyanide is soluble in excess of potassium cyanide, with the formation of a double cyanide of silver and potassium :—

$$KCy + AgNO_3 = AgCy + KNO_3, \text{ and}$$
$$AgCy + KCy = KAgCy_2.$$

When silver nitrate solution is added drop by drop from a burette to a solution of cyanide a white precipitate is formed, which quickly redissolves. At a certain stage the precipitate becomes permanent, when, in fact, the whole of the cyanide has been converted into the soluble silver salt, and an additional drop of silver nitrate produces a permanent precipitate of the insoluble simple cyanide of silver :—

$$KAgCy_2 + AgNO_3 = KNO_3 + 2AgCy.$$

From these reactions 107·66 parts by weight of silver are equivalent to 130·04 parts of potassium cyanide. A convenient standard silver solution is one of such strength that every cubic centimetre added to 10 cubic centimetres of the solution to be tested, corresponds to 0·1 per cent. of pure potassium cyanide.

This method gives good results when pure cyanide solutions are under examination, but when the solutions contain zinc it is difficult if not impossible to determine the end of the reaction. A white flocculent precipitate occurs at a certain stage, probably consisting of simple (insoluble) cyanide of zinc, formed by the decomposition of the soluble double cyanide.

This precipitation occurs long before the whole amount of potassium cyanide has been converted into the soluble double salt of silver ($KAgCy_2$) for the solution after the appearance of the flocculent precipitate still gives the Prussian blue reaction with acidulated ferrous sulphate.

A standard solution of iodine in potassium iodide may be used with great accuracy for determining the total amount of cyanogen in a solution whether in combination with zinc or not, making use of the reaction :—

$$KCy + I_2 = KI + ICy.$$

The colour of the iodine is discharged so long as an excess of cyanide is present. The sharpness of the terminal reaction may be increased by adding a small quantity of starch to the solution under examination, which gives a permanent blue colour as soon as an excess of iodine has been added.

What is most needed, however, is a rapid method of determining the amount of cyanide available for dissolving gold, for, as was pointed out above, the cyanide in combination with zinc is not available for that purpose.

The method of testing solutions containing zinc for available cyanide which was introduced by Mr. Bettel at the Robison Company's works is as follows :—Two perfectly clean flasks of equal size are taken. To each of these is added a considerable bulk, say 50 cubic centimetres of the solution to be tested and 50 cubic centimetres of water. The liquid in both flasks will probably appear slightly turbid, but the degree of turbidity will be the same in each. Standard silver nitrate solution is run into one flask until the slightest possible increase in turbidity is observed in comparison with the liquid in the other flask. This point is taken as indicating the conversion of the whole of the free potassium cyanide into the soluble silver salt, and therefore as determining the amount of available cyanide present.

The amount of gold in the solution is generally found by evaporating a known bulk with litharge, fluxing the residue and cupelling the resulting lead bullion. Evaporation on lead foil may likewise be employed.

Poisonous Properties of Cyanide.—A few words may not be out of place in this connexion. Although one of the most rapidly and deadly of known poisons when taken internally, its action as a blood poison is much less violent. Nevertheless, when introduced into cuts it produces very painful sores. The men employed in cleaning-up and in melting the slimes are subject to a peculiar eruption, especially on the arms, and complain of headache, giddiness, and general depression.

Ferrocyanide of potassium has been recommended as a remedy for the eruption ; it may be taken internally and also applied as a lotion. Considering the dangerous nature of the reagent it is remarkable how few fatal cases have occurred through the use of cyanide on a large scale. In cases of poisoning precipitated carbonate of iron, obtained by mixing solutions of sodium carbonate and ferrous sulphate, may be used as an antidote, forming internally an insoluble blue compound with the cyanide.

Hydrocyanic acid acts directly on the nervous system, causing instant paralysis, hence any treatment which will excite the action of the nerves such as applications of cold water to the spine, inhalation of ammonia, etc., may be tried in cases of faintness produced by breathing the acid vapour.

The disposal of waste cyanide liquors is a matter of serious consideration. Solutions containing 0·1 to 0·2 per cent. of potassium cyanide must occasionally be discharged and are likely to contaminate the water of the dams or streams which receive them to a dangerous extent. If some effective means of precipitating the zinc, or better still of dispensing with the use of zinc altogether, could be devised there would never be any necessity for allowing cyanide liquors to the works.

APPLICATIONS OF THE CYANIDE PROCESS.

Mr. Almarin B. Paul appears to have originated the idea of using cyanide solution in the battery crushing the ore wet. This he claims to have done with success at the Calamut mill, Shasta County, Carlifornia. He states that his plan is in all cases to crush with a weak solution, and should the ore require a higher percentage of cyanide when the first solution has percolated below the surface of the ore, after the tanks have been filled, a stronger one can, if necessary, be introduced. All the dust and disagreeable effects of dry-crushing is thus avoided. The loss of cyanide in crushing is but nominal, and is off-set by the cheapness of working and completeness of distribution of the cyanide through the pulp in the tanks. This plan has been followed of late at the May Consolidated works in South Africa, but it does not appear to be applicable to all cases, as generally when ores have been crushed wet and run direct to the tanks the pulp has packed so hard as to be impenetrable to the leach liquor. Ores containing impurities, such as arsenic and tellurium, have proved obstinate to deal with.

The consumption of available potassium cyanide may for practical purposes be divided into avoidable and unavoidable decomposition ; each of these factors varying with the composition of the ore, the strength of the solution, time of contact, and method of treatment.

Tests made on a heavy, raw sulphide gold ore by Mr. C. W. Merrill, using a 2 per cent. solution, showed that it was capable of decomposing available cyanide at the rate of 12 lbs. per ton in 24 hours, but that by taking all possible precautions this loss could be reduced to 3 lbs. per 24 hours.

The reduction in loss of cyanide seems, however, to have been set off by an extravagant loss of time, as it is necessary to continue the treatment for 7 to 10 days.

A series of extraction tests proved that a ¼ per cent. solution when reinforced each day gave as good results as a stronger one, and with a decomposition of only 5 to 7 lbs. of cyanide per ton. As the ore contained acid salts of iron and fine copper sulphides, both of which decompose potassium cyanide, the probability is that the weak solutions were rendered inert after a few hours' contact with the ore, hence the necessity of reinforcing them.

A series of experiments, published in detail in the *New York Mining Journal* of December 24th, 1892, were made by Mr. G. E. Kedzie, M.E., to determine how far the gold-bearing pyritic ores of Ouray, Colorado, could be successfully treated by the cyanide process, and also to learn the conditions under which the most complete extraction could be obtained, together with the amount of cyanide consumed. These experiments throw much light on the question of how far it is practicable to treat ores of a similar description by the cyanide method.

The samples under treatment contained gold and silver in varying proportions, ranging from 0·27 ounce to 145·90 ounces of the former, and 0·65 ounce to 458 ounces of the latter metal, the value of the high-grade ores and tailings being determined by triplicate scorification assays, and that of the low-grade ores and tailings by duplicate crucible fusions. The gangue in some cases was quartzose, in others calcareous or clayey, and contained iron pyrites, copper pyrites, and magnetite, either alone or in admixture.

(To be Continued).

QUARTERLY MEETING

OF THE

Mining Society of Nova Scotia.

FULL REPORT OF PROCEEDINGS.

The September Quarterly meeting of the Society opened at Halifax, on Thursday, 28th instant. Among those present were: Messrs. H. S. Poole, M.A., F.G.S., Stellarton; John E. Hardman, S.B., M.E., Oldham; J. H. Austen, Halifax; R. H. Brown, Sydney Mines, C.B.; Charles Fergie, M.E., Westville; F. H. Mason, F.C.S., Truro; W. R. Thomas, Montague; A. A. Hayward. Waverley; B. C. Wilson, Waverley; Dr. E. Gilpin, Jr., Inspector of Mines, Halifax; Howard Clarke, Halifax; George W. Stuart, Truro; A. Drysdale, Halifax; Geoffrey Morrow, Halifax; H. M. Wylde, Halifax. Messrs. S. P. Franchot, Buckingham, and B. T. A. Bell, Ottawa, officers of the General Mining Association of the Province of Quebec, were also present as delegates from that organization.

Mr. H. S. Poole, President, in the chair.

The minutes of previous meeting having been confirmed and Mr. A. Dick, Joggins Mines, having been elected a member, the meeting adjourned until the afternoon.

The Introduction of New Mining Legislation—Interview with Premier Fielding.

A deputation, consisting of the President and eight members, waited upon the Hon. W. S. Fielding, Premier of the Province, at his office in the Government Building, at 12 o'clock.

MR. POOLE stated that the object of this visit by the members of the Mining Society, was in respect to mining legislation--legislation which is introduced as a casual matter into the House. He asked that an opportunity be given so that all sides of the question might be presented to the Government. A good deal of mining legislation had been introduced into the House, without the opportunity being given to those who are engagaed in mining, of discussing it. He would submit that it should be an unwritten law, that all legislation respecting mining should pass through the Mines Department.

MR. FIELDING replied that the Government cannot put any restriction upon any member of the House introducing legislation respecting mining. In matters of importance respecting mining legislation the endorsement of the Department of Mines should be obtained. If it were proposed that the Government should interfere with the liberty of action of any member to bring forward legislation, that he could not assent to.

MR. POOLE—There can be an unwritten practice—a private member may have a perfect right to bring in any amendment he pleases, but the Government could say: "You cannot expect the Government to consider this carefully or endorse it, unless it has had an opportunity of having it discussed by those it is going to affect."

MR. FIELDING—That implies that no legislation is to be introduced without being considered and endorsed by the Government.

MR. POOLE—In the matter of education does not the Government control all amendments touching education?

MR. FIELDING—Our system has settled down now—to a general extent, any amendment of importance to the education law is brought forward by the Government, but all amendments do not emanate from the Government, but from private members as well. If you mean that you would like to urge, not as a practice, but as a reason, that all mining legislation should be considered and not done hastily, I fancy that merely passing through the Department would not satisfy you—the Department is not infallible. I assume you would like to know what was going on, and that you should have an opportunity to present your views.

MR. POOLE—It would lead to that.

MR. HARDMAN—Legislation which may appear on the surface as all right, and, therefore, not specially attract the attention of the Commissioner of Mines, might have an effect very apparent to a person in the profession. If we had an opportunity of knowing in due season, what legislation is proposed, we might have a voice in the matter. I will simply mention one case which occurred last winter, the changing of the courses from the true meridian to that of the magnetic meridian.

MR. FIELDING—If that was a mistake, it was done without the consideration of the Department. The Department may not have had it under full consideration. It may have been in consequence of being introduced late in the Session. You wish to have an opportunity to present your views from the standpoint of practical miners—that I take it is the main point you urge.

MR. HARDMAN—Yes; but specially refer to the amendments brought forward by private members. We desire a chance to know what legislation is introduced, and a chance to present our objections if we have any.

MR. FIELDING—The general principle you lay down, therefore, is that mining legislation should not only receive the attention of the Department of Mines, but that the miners of the country should have a chance of a hearing? All that I agree to.

MR. POOLE—There are many existing inconsistencies, *e.g.*: Why should a boy in a coal mine have shorter hours than a boy in an iron mine? New Zealand apparently took the English act and copied whole sections from it, making restrictions of the hours concerning boys, and wound up by saying "No boy shall be employed in any capacity."

MR. FIELDING—This may not have been the intention of the Act. You must not imagine that if you have the supervision of the Mines Department and a chance to discuss the Act that this will prevent any errors creeping into legislation affecting mines. The best of draughtsmen may be employed in framing an Act and yet millions of dollars may be spent in finding out what certain sections of an Act means. For instance, take the Liquor License Act of Canada.

MR. HARDMAN—A judgment was given in Quebec not more than twelve months ago to the effect that all persons are obliged, under an Act, to have a powder magazine with walls of masonry and a roof of iron.

Admitting the fact that no body of men can make perfect laws, still would it not be better to have a chance to discuss measures which are brought forward.

MR. FIELDING—Quite so.

If you gentlemen agree among yourselves and furnish us with a memorandum of the amendments you propse we will endeavour to entertain them. I fancy some will be subject to contention, yet some palpable errors may be removed. If some of your members were to make a list of the amendments you propose, not the amendments themselves, but the substance of them, we may have an opportunity of eliminating errors in the Act—do not wait until Parliament meets for some suggestion—and do not take it for granted that everything you ask for will be given. We do not want to impose upon you the duty of revising our mining law; that is our business. If you furnish us with a memorandum of what your society considers defects in our law, and a statement of what amendments should be made, it would be in order. The Government would then reframe the Act.

MR. HARDMAN—We simply came as petitioners to ask the attention of the Government, to obviate as far as possible all future errors which may be made. The examples we have cited are of what has been done in the past. We wish also to call attention to one other matter—formerly it was the custom, under an old Act to keep a record of the different mine workings, in the Mines Office.

DR. GILPIN—I might simplify matters by stating that I think you are mistaken as to the authority of an Act.

MR. POOLE—If it was not in accordance with the Act, it was in accordance with the practice of the office.

MR. FIELDING—Gold mines chiefly?

MR. HARDMAN—All metal mines.

MR. POOLE—Now, we would like to see some record kept, and a memorandum published from time to time of the depths of the workings; also of the extent of the workings in this and that district, etc., which could be amended from year to year as the workings progressed.

DR. GILPIN—Would you extend that further to locate the position of such shafts?

MR. POOLE—Yes.

MR. HARDMAN—I have nothing more to say in suggesting anything to the Government, but I will beg that the Mining Society should have the fullest opportunity of a public hearing, in order to show Parliament whether a measure was advantageous or disadvantageous in the judgement of those affected by such legislation.

In regard to the plans of deep workings, I submit that such plans would be of more value to the Province than to the individual.

MR. FIELDING—But I should think it would be desirable during the session for the Society to have one of its members present watching againt wrong doing.

MR. HARDMAN—A lobbyist?

MR. FIELDING—I anticipated your suggestion. I am not imposing such duty upon you, but I would suggest that a member of the Mining Society should watch closely the daily newspapers, and the moment he saw that any mining legislation was introduced, he could get a copy. It would not mean a lobbyist; it would simply mean an observer.

MR. HARDMAN—In 1885 such matters could be brought before the Mines Department, and a public hearing could be obtained.

MR. FIELDING—I think there should not be much difficulty in watching the newspapers, and getting copies of any measures introduced into the House, for your own protection I think you would find it useful. I would not impose this on you as an obligation but for your protection.

MR. HARDMAN—In spite of that watchfulness, somebody would come in with a private bill which would have the effect we complain of. I tried to do as you suggest last session, but the special matter of the "meridian" already mentioned, had already reached its final stage, and I was too late

MR. FIELDING—This bill must have passed through some critical stage.

DR. GILPIN—Some people came to Mr. Church and made representations——

MR. HARDMAN—(interrupting)—That is the very point we are driving at. "Some people," not representing the industry, made "representations" to the Commissioner, and he acceded to them without giving us a hearing. As a matter of fact, this amendment means that the surveyors you have in the Province are too lazy to get the true meridian, and instead, prefer laying a magnetic course. It is a serious matter, for we have had various instances where the variation of compasses has caused direct loss and litigation. The matter of changing to the true meridian was thoroughly threshed out by the Society's predecessor, the Gold Miners' Association, and the change to true meridian received the unanimous endorsement of the Gold Miners' at that time.

MR. FIELDING—I formed the impression at the time that it was a mistake and it should be corrected. From what you tell me, it is against the opinion of the Mining Society?

MR. HARDMAN—The matter was threshed out in the Gold Miners' Association, and was recommended by that body for adoption.

MR. FIELDING—Are you all of the same opinion? I think it is a matter upon which experts may be divided.

MR. POOLE—Stone posts had been established in the coal fields years before, and the legislature had confirmed them as the correct corners, so that we have had no occasion to look into the matter.

MR. HARDMAN—I might say further, that this amendment did not affect the old areas, it was only to apply to new ground laid out subsequently to the passing of the Act. It was only in regard to new areas, they were to be laid out by the true meridian. I simply mention it as an example where legislation was passed which was not representative of the opinion of gentlemen connected with mining work.

MR. FIELDING—I remember hearing the discussion at the time the Governor-in-Council gave a hearing. (To Mr. Hardman)—At what stage of the bill did you offer your objections?

MR. HARDMAN—I went up to the House on the afternoon of the day I saw the amendment in the newspapers, and asked for Mr. Drysdale. He informed me it was too late to object, that the bill was passed.

MR. POOLE—We think most of these amendments to the mining laws would be better if more time was given to their discussion.

MR. FIELDING—Suppose a session is approaching the end, the Commissioner may have his attention directed to something erroneous, then he would try and remedy it. At the end of last session we had many things to do which should have been done earlier in the session. When the Commissioner believes a mistake has been made he rushes in to make an amendment. Every member of the House has his undoubted right to bring forward any legislation with respect to mines, but to say that no legislation should be introduced without supervision as you suggest, is going too far. An opportunity should be afforded the Mining Society and gentlemen interested in mining to present their views, and to represent what is most desirable, but the government cannot make it a positive and unbending rule.

The deputation having thanked the premier for his courteous hearing then retired.

Afternoon Session.

The members assembled at two o'clock, the President in the chair.

The first paper for consideration was:

Effect of a Lightning Discharge at the Scott Pit.

By Charles Fergie, M.E., Westville, N.S.

The Scott pit shaft is 226 feet deep and down to the second seam, which is 12 feet thick, some eight feet being worked. For some months past the only work done on this seam has been the driving of a pair of slopes to the deep to intersect the main seam by way of a tunnel already driven. These slopes are 2,000 feet down, and the driving of them was proceeded with until about the end of July last, when, in consequence of the colliery supply of water for steam purposes showing signs of giving out, they were stopped, and all work confined to the main slopes, the Scott pit being laid idle. Previous to this the mine had been ventilated by a Schiele fan but having no steam to spare, in consequence of the scarcity of water, the fan was stopped and the mine received its supply of air by natural ventilation only. The seam being a very gassy one this mode of ventilation would not be sufficient to keep the mine clear, but as no person was to enter the mine until the normal state of affairs was again restored, it was not anticipated that any danger from an explosion of gas could possibly occur. The air of the mine being highly charged with fire damp, the necessary means of ignition were soon to be forthcoming. On the afternoon of the 8th of August, about 4.50, there was an electric storm passing over the vicinity of the colliery, and which discharged itself. The general office was struck by lightning and the front part of the building demolished. At the same time it struck the iron pulleys of the head-frame at the Scott pit and travelled down the steel winding rope entering the mine, and instantly igniting the gas accumulated therein which caused a

severe explosion, the force of which demolished the buildings on the surface at the upcast, and at another shallow shaft called the "stair pit." The writer, who was sitting writing by his office window, could not distinguish any lapse of time between the thunder clap and the explosion of the mine, so simultaneous were they. It being the opinion after the explosion that fire existed below, it was decided without delay, seeing that the ventilating shaft and fan were damaged, also the cages of the winding shaft, to seal up the mine, and this was done without mishap within about an hour and a half. The mine has since remained sealed and will likely be reopened about the end of October when the busy shipping season is over. The writer will then be in a better position to state the actual effects of the explosion underground and proposes to supplement this paper at a later date. Though having read of lightning having entered a mine by way of steel ropes, etc., the writer is not aware of any explosion having been directly traced to that cause before the one now referred to. This accident, and which was happily unattended by loss of life, clearly demonstrates that no mine where gas is allowed to accumulate to an explosive point can be considered safe from an explosion when it is connected with the surface by some conductors of electricity such as wire ropes, water pipes, steal rails, etc. It also serves to point out that where bore holes are put down from the surface for the purpose of rope haulage underground these holes and ropes should not pass through a return airway or where gas is likely at any time to be mixed with the air in high percentages.

Discussion.

MR. POOLE—That lightning can damage a pit has been spoken of, after the more conclusive case could be had, and the electric fluid finding its way into the recesses of a mine and causing an explosion of inflamable gas, has been on several occasions discussed, but I do not remember having read of any case that so conclusively proved that lightning had actually fired gases in a pit than the present one. No other alternative was possible, no one was below, no one was about the mine at the time, and simultaneously with the explosion, there was a violent electric discharge which injured the gable of a building some 200 feet distant. The earth tremor from the explosion was felt at Stellarton and caused those who noticed it to remark that they never before noticed thunder to shake the ground as did this particular report.

On several occasions lightening has been seen to run along the iron rails underground and in some cases men have complained of being partially stunned. Mr. G. I. Burns in Vol. III., Part 4 of the Trans. Fed. Instit. M. E., 1892, mentions several cases where lightning was seen to enter coal mines in New Zealand and a premature blast in the Hoosac tunnel which killed some sixteen men was imputed to lightning entering the tunnel by the battery wires.

The question came up before the Accidents in Mines Commission in 1880, and in answer to an enquiry from the Secretary of State Messrs. Abel and Clifton wrote :

"The electrical excitement consequent upon the heavy storm which occurred at the time of the explosion as Risea would have had no effect 'in making gases more explosive' in other words the explosive properties of mixtures of fire damp and air are not influenced by violent electrical excitement.

"Electrical means of signalling may be used in localities filled with explosive mixtures of gasses with perfect safety, provided the battery employed will not produce a spark under any circumstances likely to occur in the working of the signals.

"There is no difficulty in obtaining batteries which are perfectly safe.

"We think it right to point out that it appears to us not impossible, considering the arrangements frequently existing in respect to metal guides, and to the wires used in the ordinary means of signalling, that during a violent storm a portion of an electrical discharge may find its way into workings and fulfil conditions necessary for the ignition of gas even at some distance from the pit's mouth."

MR. FERGIE—There is no doubt but that the explosion occurred through the lightning striking the winding rope and entering the mine. Simultaneous with the striking of the head-frame it struck the building. The conditions underground were favorable for an explosion—the slopes were full of gas.

MR. BAIRD—I thought I had an instance of the same kind in my mind, but I cannot recall it just now.

MR. FERGIE—You may not have the same conditions for an explosion in the mine during the next 500 years—that is for the lightning to strike that spot and have the air in the same condition—the air was at an explosive point.

MR. CLARKE—How would this effect the working of mines with electrical machinery ?

MR. FERGIE—Where you have your ventilation up to an explosive point electrical machinery would affect ; otherwise not.

MR. HARDMAN—At what point would the lightning probably leave the cable ?—*i.e.* where was the flash underground ?

MR. FERGIE—The cage was hanging at the end of the cable about 25 or 30 feet from the bottom and the discharge occurred at this point. It would be impure air right up to the cage from the bottom. It would be stagnant for about eight days.

MR. HARDMAN—So the flash would be at the bottom ?

MR. FERGIE—Yes.

DR. GILPIN—There was a case on the continent where an explosion occurred which was attributed to lightning. There is a case where lightning entered a pit and traversed the workings but did not do any damage. It was about twelve years ago.

A vote of thanks, moved by Mr. Hardman, seconded by Mr. Clarke, was accorded to Mr. Fergie for his valuable paper, and was passed unanimously.

Notes on Practical Mining, Applicable to some Gold Mining Districts in Nova Scotia.

By MR. W. R. THOMAS, M.E., Montague, N.S.

In treating this subject I propose to evade the much discussed and debatable question, as to formation of the "belts" with the contained auriferous quartz "leads," as found in Nova Scotia ; leaving the solving of this problem to far more able geologists than myself, as well as to men who have had far greater experience in gold mining generally.

I intend asking you to consider a few principles, which may be applied in conducting mining operations in some gold mining districts of Nova Scotia, practically taking my stand on experience in the Montague district, together with information gained from conversation with people engaged in other districts in the province.

I also desire you to look on the following as being the conclusions of one who has had but a comparatively short experience, not only in gold mining, but in gold mining in Nova Scotia. However, I must candidly state that I cannot concur with the opinion of some mining experts, when they speak of the absurdity of men, who have only previously had experience in mining for other ores or metals, entering the profession of gold mining. I look on common sense and judgment as being the first and foremost principles which men in all the various branches comprising the mining profession should possess, and if possible, cultivate.

SURFACE OPERATIONS—In this, as well as in many other countries, some huge blunders have been made, not only in the erection of suitable machinery, but in the extent of the plant required. I venture to say that had the amount of money which has been unadvisedly expended in erecting extensive mining plants, been spent in mine development, the list of successful Nova Scotian mines would be much larger than at present. It is highly essential to have a sufficient quantity of machinery, enabling one to easily deal with the present output, but to commence the erection, on the laying out of a plant which the present developments do not warrant, looking a long way ahead in the dim future, is most certainly monstrous in its absurdity, and, in fact, a suicidal policy.

If a five stamp mill is of sufficient power to mill all the available quartz, why erect a 10 or 15 stamp mill ? Or if a 30 h.p. engine is equal to working your pumping and hoisting machinery, is it economy to erect an engine of 80 or 100 h.p. ?

Naturally, when water power is within reasonable reach, it is wise to utilize it, assuming that after full consideration from a business point of view, the profit derived will be sufficient to warrant the necessary outlay.

Where this much coveted power is not within reach, procure the strongest, cheapest and most economical style of machinery, of sufficient power to cope with your present requirements, remembering that the less machinery you have the correspondingly less will be your account for supervision, fuel, rates and taxes, &c., &c.

One of, perhaps, my strongest reasons for conservatism on this point is, that it is especially discrete where actual mining is so expensive—surrounding rock hard, and "leads" small—to reduce the surface expenditure to a minimum. Of course this policy should be practised in all cases.

It is not possible to develop a mine in a day, week, month or even a year, as mining operations are not carried on as rapidly as one might bring himself to conceive when using the parallel ruler, scale and pencil. To "mine" in the rock and to "mine" on paper are slightly different in their natures ; the result in many cases not comparing as favorably as one might desire, one with another.

I have not had any experience in importation of machinery in this province, but am of the opinion that the government of this country would, by the abolition of importation duties, create a confidence between themselves and foreign investors which, in the future, they might not regret. I say this not thinking disparagingly of the class of mining machinery locally manufactured ; in fact I have pleasure at having an opportunity to state that, in my opinion, the machinery manufactured in this country is of a first class order, and difficult to surpass ; and I also feel assured that the local manufacturers are not afraid of competition.

LOCATING OF PLANT—It is also highly important in the laying out of a mine, that is the commencement of the necessary surface erections, to localise your plant as much as posssible with a view to practising economy in the amount of labor employed in the supervision, &c.

In many countries, including Nova Scotia, economy in labor is an important matter, which should not be overlooked. I am personally acquainted with many instances where vast sums of money have been expended in the erection of mining machinery before even the most important considerations have been thought of. For instance, air compressing machinery on the top of a mountain, rendering the item, carriage of fuel, excessive ; all of which might be saved by the purchase of 1,500 or 2,000 ft. of air pipes.

UNDERGROUND OPERATIONS—We have all heard discussions as to the advisability of vertical shafts in preference to the inclined shaft sunk on the dip of the "lead." The former appear to me to be sure investments when large quantities of rock are being handled, but where, as in many districts in this province, the surrounding country rock is exceedingly hard and where practically small quantities of rock are being handled, I believe that the inclined shaft sunk on the dip of the vein, proving the portion of "lead" sunk through is the more advisable.

The consideration is whether the amount saved in hoisting by application of cages against skips, is sufficient to warrant the outlay necessary to sink a vertical shaft, which has, undoubtedly, to be classed as dead work.

When several "leads" are known to exist in close proximity, where the intention is to cross-cut and develop them all from one centre, and especially where these "leads" are practically uniform in quality, it would probably be advisable to sink a vertical shaft.

The more important consideration, that is the prospect of deep mining, will be dealt with at the conclusion of this paper, under pay streaks, their persistency in depth.

I believe that everyone will agree with me when I say that systematic mining—the developments carried on by means of drifts about 100 ft. apart which are connected by winzes—is far ahead of the method—sinking several shafts and carrying on underhand stoping at the same time—which has been applied in many cases in this province. Assuming that the former system be adopted, the next consideration is what method of stoping should be applied. This, I take it, is a matter in which the mine manager has to exercise his discretion and judgment.

I have seen some portions of ground in the Montague district where, in my opinion, by applying overhand stoping, one is likely to not only lose a portion of the quartz among the debris deposited on the scaffold, but lays himself open, in all probability, to losing the gold, especially heavy gold.

This most coveted metal is undoubtedly highly attractive in its appearance and one gets so entranced by its sight, that he momentarily forgets who is the rightful owner.

Large quantities of rock can be handled more cheaply by the application of the overhand system, as shoots can be reared up with the stope, the intervening spaces being filled with debris.

I am a great believer in the application of the contract system in carrying on the developments of the mine. By doing so you employ the miner's brains, in addition to his manual labor. What interest can one expect the day's pay man will take in his work or in its result ? Manipulation of labor is a very important factor in mine management.

A great deal more attention might be paid to cross-cutting, particularly at depths where the pay streaks are known to be continuous in richness. The application of rock drilling machinery is essential for this work, as well as for the general development of a mine.

PAY STREAKS—THEIR PERSISTENCY IN DEPTH—I look on this as being really the most important of all considerations relative to the future success of gold mining as an industry in this province.

When one looks around at the many gold districts and sees a large number of mines that were once successful closed down, the first question that presents itself is : What is the reason why operations have been suspended ? The usual local reply generally consisting of : Could not cope with the water, reckless management ; had a barren streak for a few feet, and just before closing down, rich quartz was discovered right at the bottom of the deepest shaft ; never should have stopped, &c.

It is, in fact, nearly impossible, according to local opinion, to find a mine that has been really closed down through barrenness. In nearly every country one hears the same, what should be termed sentiment.

The next question, at what depth was the mine when operations were suspended, together with the reply, is something that requires consideration.

I have found when making this enquiry, that the approximate depth of abandoned Nova Scotian mines is from 200 to 350 ft.

When one gets this information he naturally concludes this must surely be the depth where the pay streak discovered at the surface ceases to be continuous in richness. There is one argument which may be fairly raised against this conclusion, that is on account of the former primitive system of mining applied. The cost of pumping, hoisting, &c., was excessive, and as depth was attained the general working cost proportionately increased, until the streak which paid from the point discovered to its present depth would no longer pay to work.

At present I am inclined to support the former conclusion, that is that the pay streaks become practically barren at a comparatively shallow depth—from 200 to 400 feet, but hope that this paper will be the means of creating a discussion which will enable the Society's members engaged in gold mining, to place on record their views, together with experience on this all-important subject.

As the extent of the mining machinery required for the working of our mines, depends very largely on this consideration, it is essential to know as far as possible the facts of the case, therefore we, as a mining society, having the interest of the mining industry at heart, should openly discuss a matter of this kind, seeking to aid the industry by placing it on a sound and creditable basis.

The inference drawn at first sight appears to be decidedly derogatory to the gold mining industry.

Seeing that there are an innumerable quantity of unexplored quartz "leads," running parallel to those on which good pay streaks have been found, I am of the opinion that it would be more advisable to ask investors to place their capital for the exploiting of these "leads," rather than to work abandoned "leads" possessing a good record.

Some people may argue that in every probability there are other pay streaks which occur below those already worked, and if the mines were developed to a depth of, say 600 to 800 feet, these streaks should be discovered. Assuming this to be a feasible theory, it would be a very difficult matter to secure capital with simply this object in view, as the development of Nova Scotian mines below 300 feet, through a hard dense quartzite, is an expensive business.

If the government of the country takes any inetrest in their gold mining industry, and if those in charge of the Department of Mines, by making the necessary inquiries, and gathering together the requisite information, arrive at the conclusion that the prospects of deep mining are favorable, would it not be putting it in a practical form, if they—the government—were to offer a bonus as an encouragement or rather inducement, to any investors attempting this form of speculation?

I am informed that the governments of Queensland and Victoria, on two or more occasions, voted sums of £1,000 and upwards, to promote the principle of deep mining together with other branches of industry closely allied to the same.

While on the subjeet, I would like to take this opportunity of calling attention to the mines inspection, as conducted by the representatives of the Department of Mines.

I have been engaged in mining in this province for nearly a year, and have never been officially called on, by either the inspector or deputy inspector, although, I believe, an inspection of the mine has recently been made by the deputy inspector.

I anxiously await the publication of Mines Report, 1893, when the work will probably be particularized in the deputies' annual report.

Candidly, what good does the publication of small matters of this kind do? In fact, it surely assists in keeping capital out of the country; for what speculator would for one moment think of the importance of gold mining in Nova Scotia after reading the extract from the official Mines Report (1892), as published in the *Critic* of April 14?

There is undoubtedly plenty of room for improvement in this direction. It appears to me that either the government or its officials might plead—"We have done those things which we ought not to have done, and we have left undone those things which we ought to have done."

I may state in conclusion, that many of the rich deposits of tin-oxide in Cornwall were discovered at a great depth, and that districts, where this mineral is found practically near the surface, are looked on as shallow districts, where the chances of deep mining are not as favorable as in the former districts.

I make this statement, with a view of calling attention to the many large quartz "leads," existing in the province, which on account of their not showing gold at their outcrop, have been apparently passed by as worthless.

Discussion.

MR. HARDMAN—This Society is much indebted to Mr. Thomas for his valuable paper. I want to endorse Mr. Thomas' conclusions in almost every respect, but at the present time I cannot agree with his conclusions in regard to pay streaks. It may be true, and it may not be true, and the following case may be the "exception proving the rule." Last week in Oldham on the Standard Company's property at a depth of 520 feet we got the top of our pay streak, I simply state the fact that on one lead, at any rate, the pay streak has been cut at 520 feet depth on the incline.

MR. POOLE—At about what angle of inclination?

MR. HARDMAN—At 43 degrees.

MR. POOLE—The Wellington was on an angle of that inclination, was it not?

MR. HARDMAN—The Wellington was sunk 300 feet on the incline of 45 degrees, then the pay chute was followed for 300 feet to the westward at a dip of 35 degrees. The length of the winding rope was 600 feet, but the depth on the incline was 500.

MR. WOODHOUSE—I would like to ask any gentleman present who has been looking up the theory of pay streaks and taking vertical depths, whether he has found gold 400 feet below the surface?

MR. POOLE—How deep is the Salmon River mine?

MR. STUART—300 feet.

MR. HARDMAN—Taking our 520 feet on the incline would make about 340 feet vertical.

MR. WOODHOUSE—I think Mr. Thomas can give us some pretty valuable advice on this point. He is down about 300 feet. One of the deepest points in Montague was on the Rose lead, worked by Mr. Lawson—at one place it is 345 feet and the other 380 feet.

MR. THOMAS—The Rose lead is 365 feet, and the other lead worked was cut off by a dislocation.

MR. WOODHOUSE—Was that 365 feet vertical?

MR. THOMAS—Pretty nearly vertical.

MR. HARDMAN—In this particular chute I have reference to it is as one continuous streak for nearly 1,700 feet in length, and will extend to probably 2,000 feet.

MR. THOMAS—We had a streak at Montague. I drove a level at 264 feet from the surface and found that throughout, the streak was fairly profitable for every 100 feet. With regard to the Lawson streaks—I think they were the result of intersections—so I would gather from the map and from information received from miners living in the district.

MR. HARDMAN—That lode would be similar to the streak found in Oldham in 1877 by T. N. Baker. It was made by intersections of angling veins with the main lode—the angle of dip of lode would be 60 degrees.

MR. THOMAS—What would be the law of streaks in the Windsor Junction property at Waverley?

MR. HARDMAN—I do not think there are any facts recorded to show any law. The shaft is nearly down to 400 feet on the Tudor lode. I have been told the inclination of the streak is 35 degrees to the east—but so far as our own workings went we failed to discover any streak whatever.

MR. HAYWARD—On the Lake View property—Dominion Lead—the streak extended from the surface and was cut off by a break at 360 feet on the incline.

MR. WOODHOUSE—I would like to know the reason why some of the mines have been closed down—I would mention the Rose for example, also the Lawson. I would like to know the reason for closing down these mines. Perhaps the pumps did not compete with the water—or perhaps they did not wish to make any more money.

MR. STUART—I think I know something about the Lawson. I was the last man who worked it. I had had just such favorable reports as that made to me—"It is as good at the bottom as any part of the old workings." Mr. Lawson told me the last was poor and had not paid for several months. But my object in pumping out the mine was to drive some cross-cuts in what I call the "side lead." I think that side lead had something to do with the richness of the Lawson mine, yet it did not make the streak entirely, nor was there any regular gold streak. The gold was more in pockets and not in line. They were at different parts of the whole workings, not continuous but distributed over the whole ground that was worked, but the quartz taken out between these workings was not barren. At 360 feet it was pinched to about two inches and only gave me two pennyweights to the ton, but in the western end where the lead was larger, it gave from 15 to 20 pennyweights, but the pay ground was short. The plan kept by Mr. Lawson showed conclusively that there was no regular pay streak. He crushed by contract for each crew of men separately each month, and indicated on his plan the exact amount of quartz taken out of each portion of the ground, and the exact amount of gold obtained.

MR. WOODHOUSE—A copy of that plan is in the Mines Office, is it not?

MR. STUART—I think it is.

MR. POOLE—I think it is published in the report of 1876.

MR. STUART—I quite agree with Mr. Thomas in regard to the various reports of the mines which shut down, and that it would be well to compel mine owners to keep a plan on file in the mines office when the mine is shut down; it would prevent a great deal of toil.

MR. CLARKE—Is there not a provision to that effect now?

MR. STUART—It occurs to me that there is something to that effect.

DR. GILPIN—That point has been talked of for some time and my idea was to have a man make it his business to go and get that information and put it on a plan, so that it would be placed on record.

MR. STUART—Would it be too much to have that attached to the inspector's duty?

DR. GILPIN—I am afraid it would. At first it would take a great deal of work to get the thing up; after that not so much.

MR. POOLE—Appoint another officer.

DR. GILPIN—There was an amendment put in the Act by James A. Fraser to that effect. To do that would simply mean another officer. Now that the royalty is getting better it has come up again.

MR. STUART—I think it would not be too much to make it obligatory on the mine owner.

MR. THOMAS—In the west of England all mine owners are bound to keep plans and data up to date, and when the inspector comes on his round he sees that the work is done.

Government Aid to Mining—A Suggestion?

MR. JOHN HARDMAN—The title of my remarks as printed by the secretary is "Government Aid to the Mining Industry—A Suggestion?" I was careful to have at the end "A Suggestion," and I beg that it be kept in mind, but from the interview of our committee with the Premier this morning, and from the discussion on Mr. Thomas's paper this afternoon, it is quite evident that the suggestion is an opportune one. As a government function we would have good precedents for the government's undertaking to give aid to the mining industry. I notice that Mr. Thomas in his paper speaks of the sum of £1000 being voted in Victoria, In the fiscal year of 1886 the government of New Zealand spent over $50,000 in water races, nearly $150,000 in roads, and over $180,000 in actual construction or subsidizing of other works and for the purposes of deep mining and of furthering the interests of mining generally. The total amount appropriated for gold fields alone in that year being nearly $400,000.

The Spanish government recently spent over $200,000 for a new building for a mining school in Lisbon, and in New South Wales they are spending large sums every year—£40,000 I believe. So that we have very good precedents when we go to the government of this country and ask them to help to forward the mining industry. I am now speaking particularly as a gold miner, but I do not see why the idea should not be equally servicable and valuable to other kinds of mining. At the outset the question arises if the government is to extend aid to mining, is it to the Provincial, or to the Dominion Government we should apply? I think it will be remembered by some here that in the year 1881 the Provincial and Dominion united in having surveys made of Lawrencetown and one or two other districts and they contemplated making surveys of more districts but the work was discontinued because it was found to be too expensive. It seems to me that we have no claim on the Dominion Government in this matter, as all the royalties are payable to the provincial treasury, and I do not see, therefore, any reason why the provincial government should not bear all the expenses. There have been some previous efforts in this line of asking government help; propositions were made as far back as 1887. Mr. Thomas suggests in his paper that the government should give a bonus. I think the original form in which government aid was asked was that the government should sink a test shaft in such a place as should be desirable in order that the existence of workable veins at great depths might be proved. But a difficulty arose at once; in which district should this shaft be sunk? Each district could put forward claims that would make a decision difficult, if not impossible, and this proved a fatal objection.

The next suggestion was that the first man who put his shaft down to 1,000 feet should receive a bonus of $10,000 or like sum. But there were certain valid objections raised to this proposition. A shaft sunk in Montague might not tell us about the strata in Renfrew, or Wine Harbor, or any of the other districts. Again it was suggested by the late John Kelly that the government should remit the royalty on all gold coming from certain depths. Gold from below 500 feet to 1,000 feet should pay a royalty of only 1 per cent., and from below 1,000 feet should be free of royalty, in other words the amount involved was a bagatelle and not worth considering.

And more recently still the suggestion has been made that the government should purchase a diamond drill, and bore from 3 to 4 holes in each district to test the existence or otherwise of workable veins. All of you here know that a bore hole might go down within 12 or 13 feet of a pay streak and yet the core show poor ground, the drill again may go through a pinched portion and fail to indicate any quartz lode at all.

In spite of the failure of these several schemes to materialize, yet it is highly desirable that the government should extend such aid and help to the gold industry as would tend to advance the output and increase the knowledge we now possess of the resources of the industry. Therefore, I venture to bring forward at this time an idea which has been gradually taking shape with me, and which I believe would be of permanent value and material benefit to the whole metallic mining interests of the province, and especially to gold mines.

I suggest the construction of detailed topographical maps of each prominent district, accompanied by a monograph in pamphlet form, which shall explain the map and give fuller letter-press descriptions than the scale of the map may allow.

The details yet remain to be worked out, but the salient points I may describe as follows:—

The map, constructed on a scale of *not less* than 200 feet to the inch, and preferably 100 feet to the inch would show—first, the area lines, distinctly and clearly indicated by a faint green line, the area numbers being also printed in the same color; secondly, the roads, in a brown shade; thirdly, all known and located lines of faults or breaks by a conventional dotted or broken black line; fourthly, the out-crops, or worked portions of the out-crops, of all discovered veins by red lines; fifthly, all streams, swamps and wet ground in blue lines, tints or hatching; sixthly, showing contour lines, either 10 or 20 feet apart, over the district, in continuous faint black lines.

In addition, the location of each shaft or incline, over 20 feet in depth, should be noted and the position of buildings of a permanent nature, as mills and steam hoists, etc., should be marked.

By a system of letters, with corresponding references in the margin, a great deal of information could be placed in small compass, directly on the map sheet, which should, of course, be detachable from the pamphlet for convenience of reference.

To simplify matters and explain the scheme to you much more graphically than I can talk, I have prepared a map of a portion of the Oldham district, showing about 27 areas out of some 500. (It is to be regretted that owing to the time involved in the reproduction in colors of Mr. Hardman's map, we are not in a position to publish it in this issue.—Ed.) I may say here, that the intention is to confine the map closely to the limits within which gold bearing lodes have been found, and not to extend the map beyond the worked limits of any district. I regret that the time at my disposal has not permitted me to put the contour lines upon this sketch of Oldham district, but I am sure you will agree with me that they should be an essential part of the map.

The monograph accompanying each map could be made up largely from the provincial records, and the reports of the Dominion Geological Survey, supplemented by information obtained during the actual mapping of each district.

This monograph should contain, amongst other things, a full official record for each year of the amounts raised and milled and the yield therefrom; descriptions of the more important veins and their workings; the peculiarities, mineralogical and lithological, of the district; sections of the district at important points, and simple line drawings of the underground workings of the chief producing lodes. Also such other available information, technical, economic and geological, as would help to make a complete history of each district to date.

Doubtless one of the first qustions I shall be asked is: "What will it cost?" To this I am prepared to give an answer. I have consulted Mr. Faribault, of the Dominion Survey, on this matter, and have availed myself of his experience and advice. Primarily, there are but thirteen or fourteen districts which I would map as suggested; I would say that a district which has not produced a minimum of 5,000 ounces since discovery, was not important enough for this map. Starting therefore with 15 districts the cost of fieldwork, plotting, compiling, printing and lithographing, should not exceed $20,000. Some districts will cost more than others, for example: Sherbrooke and Waverley, the two largest and greatest producing districts, would probably cost $2,000 each. While Wine Harbor and Oldham would not cost over $1,000 each.

Much of the work could be done cheaply. A provincial land surveyor with assistant could go over the ground first, laying out area lines, marking each corner with small temporary stakes, and at each tenth stake putting in a more permanent monument; after him let two men come on with a level—engineering students from Dalhousie or McGill, who would be glad of the experience in the field—and run the contours. Finally let the chief, or geologist, come last with one good assistant; marking on the map as plotted by the two corps preceding him, the various veins, faults, etc., etc., as I have already mentioned, and collecting and arranging the large mass of valuable matter now solely recorded in the heads of the older local residents whose ranks time is steadily thinning.

From two to four, or an average of three, of these maps and monographs could be completed each year, putting on the Provincial Treasury a strain of not over $4,000 to $5,000 per year. After these maps are once published it is only a matter of local statutory regulation to have them kept up to date by the Mines Office.

I do not believe that there is a gold mining corporation or firm represented in this room but would have saved thousands of dollars in preliminary exploitation work had such maps as are proposed been available to him before he began work.

I may go further and say that I do not believe the Province of Nova Scotia can better advertise her resources abroad than by the dissemination of such maps and documents. It appears to me to be a case of killing two birds with one stone, advertising her mineral resources, and substantially helping the mining industry at the same time.

And I close by urging upon you the necessity of preserving in some form the data we now have in the memories of the older miners. Twenty years from now they will all be dead, and information gained will be dead, and information gained will be at second-hand.

DR. GILPIN—There is no doubt about it now is the time to do this thing. In respect to the remarks in Mr. Hardman's paper about the survey made by Mr. Dawson—the facts were that an agreement was reached between the Dominion Government and the Local Government in 1880 that they would join in bearing the expense of a topographical survey of the gold district starting from Halifax and extending eastward. This was projected in order to facilitate and expedite the work of the Geological Survey which was working from the east to the west on the Atlantic coast, so that whenever he struck the ground which had been previously surveyed he could get through his work more quickly. The amount of expense was considered too great and the survey stopped at the end of the first season. The plan of the work of Mr. Dawson became the property of the local government and has been in frequent demand and proved very useful for many purposes connected with surveys and location of waterworks, etc., and has undoubtedly saved expenditures in surveys, and paid for itself many times over.

A vote of thanks was unanimously accorded Mr. Hardman for his valuable remarks.

Members Dine Together.

Promptly at eight o'clock the members to the number of thirty filed into the St. Julian dining room and sat down to an excellent dinner served by the proprietors of the Halifax Hotel. Mr. H. S. Poole, President of the Society, occupied the chair. Among the other guests present were noticed the Hon. W. S. Fielding, Premier of Nova Scotia, and Mr. S. P. Franchot, Vice-President of the General Mining Association of the Province of Quebec. Ample justice having been done to the generous bill of fare, a number of toasts were given, the speakers of the evening being Premier Fielding, Mr. John F. Stairs, M.P., Mr. Arthur Drysdale, Mr. R. H. Brown, and Mr. S. P. Franchot. The proceedings were enlivened by a programme of songs and choruses to which Messrs. G. J. Partington, W. R. Thomas, Alfred Woodhouse, B. T. A. Bell and others contributed, Mr. Ernie Wylde officiating with much acceptance at the piano. Considerable diversion was caused by the droll and humorous selections most effectively delivered by Mr. Frederick Taylor, of Lowell, Mass. The fun was kept up until a late hour, indeed as far as we recollect "the wee small hours ayont the twal" were well advanced before the members dispersed, thoroughly pleased with their evening's enjoyment.

Excursion to the Montague and Waverley Gold Districts.

On Friday morning a number of the members drove out in a four-in-hand to the Montague and Waverley gold mines where an interesting time was spent at the properties of the Symon-Kay Syndicate, the Nova Scotia Gold Mines (Ltd.), and the West Waverley Gold Co. (Ltd.) An inspection was also made of the work being conducted in the Laidlaw's Hill tunnel at Waverley. In a future issue we hope to be able to make a more extended reference to the work and prospects of these districts, which lack of space, it is to be regretted, prevents in this issue. An excellent luncheon was served at Beech's Hotel. The members reached town shortly after dark, having, notwithstanding the wet weather which prevailed, greatly enjoyed the drive and the outing at the mines. and each and all returned with a keen appreciation of the many courtesies that had been extended to them, notably by Messrs. Hardman, Wilson, Thomas and Woodhouse. It is greatly to be regretted that on account of other engagements a large number of the members of the Quebec Association were unavoidably prevented from participating with their brethern in Nova Scotia in the pleasures and excursions of this meeting.

Ontario Mining Association—President Hammond's Address.

At the annual meeting of the Provincial Mining Association of Ontario, at Sault Ste. Marie, on 4th October, Mr. J. R. Hammond, of Sudbury, President of the Association, said:—

"I wish upon the occasion of our annual meeting to recall for a moment the work we have done in the interests of mining and the formation and direction of mining policy in this province since we organized in this town on the 7th of October, 1891, and to touch briefly on the work we may in future aid in accomplishing, as well as the means at our disposal for bringing this work to a successful issue.

It was due largely to the suddenly expressed intention, and as sudden action of the Ontario Government regarding its mining policy, without previously sounding the opinion of our citizens at the polls or otherwise, except the few days allowed between the rapidly succeeding readings of Bill that thereupon became law, that our infant mining industry suddenly found itself more tightly than ever wrapped in the swaddling cloths of what we then believed, and still have reason to believe, is an extremely tight-fitting and restrictive mining policy; in spite of the fact that a Royal Commission, appointed by this same Government, had but lately finished a comparatively exhaustive examination, not only of our mineral resources, but of ways and means, and had ended by unanimously advising liberality and urging that room be made for expansion. Failure to take the advice thus asked for, at vast expense, and the fact that exactly the opposite was made law, at a time when the industry showed some signs of revival after a long period of depression and inaction, rapidly bred sharp criticism and the desire for the creation of a society whose chief object would be the safeguarding of interests, than which none are more important to individual and national prosperity. How far this was done and what has since been accomplished, is already become matter of history, but I might be permitted to note as some of the more important events with which we have been so closely identified, the pressing of our just claims upon the attention of the Government and the electorate at large, by means of petitions and addresses, and the enlistment of the sympathy and co-operation of the press, with the positive result of causing the legislature to pause and recede from an untenable position, and the awakening of the people to the vital importance of the issue before us. To be factors in endeavoring to achieve such important results we have conceived to be our privilege as British subjects and as Canadians, and our duty and our presence and influence here to-day, gathered, as we are, from far and near, is the best proof we could have that there is work still to be accomplished in this cause.

But it is not enough that our interests are now united throughout all this vast Province; difficulties have still to be faced in the development of our mineral resources, resources which, as year by year goes by, are proving themselves as rich and varied as those of any country in the world, and we are met to devise ways and means for bringing their legitimate claims still more prominently to the attention not only of our own citizens, but of the world at large. Our field is the world, and to the world we must appeal. We must continue to show it what we have got and cultivate its acquaintance and assistance, and unite our efforts with those of competent and willing outsiders in building up a mighty mining industry. This has been done by other countries, and it can, and will, be done by us. As a well organized association we can but aid in this great work, and with all the assistance we can obtain, bring it to pass.

As to ways and means, though it might yet be said that we are a feeble folk, yet let no one despise the day of small things—great oaks do out of acorns grow,—and when we shall have ceased to quarrel and fight for place and power in petty party politics and shall have really and truly begun to study the lasting interests of a young and struggling country, we shall then truly recognize as individuals and as a country what we need to aid us in extracting a livelihood whence it is pre-eminently honorable to deprive it from mother earth. That the mining industry can lay claim to the best right to existence has never been or can be disputed, and I say it is a sorry spectacle to see unnecessary restrictions put upon manual labor and the willingness to labor on the part of either individual or government. Such restrictions we charge today upon a government which is responsible for the best utilization of not only our mineral, but I may also add incidentally our agricultural and other resources in a manner that leaves honest labor freedom to work out its salvation. Time and again, as also during the present year, have we appealed for aid, or mere recognition in our feeble endeavors, only to be turned away with promises unfulfilled and amounting to nothing, or told that it would not do. We care most for this country which we claim as our birthright, and upon which we are at liberty to expend our labor and reap the fruits thereof, and not for any political party chiefly eager to wield a power we should yield only on an honourable and definite understanding and agreement that ours will be fulfilled, and not upon an unseemly and hasty party struggle in outdoing their opponents for that power and its consequent emoluments at the expense of this country. But this not only desirable, but necessary condition in all economic and honest government can only be fully obtained by thorough organization and presistence of endeavor on our part.

It is believed, and some would know, that we are on the eve of a provincial election, and that the usual squabble for votes will ensue. Gentlemen, vote for no man who is not in sympathy, heart and hand, with the temporal welfare of his country, and especially of his immediate neighborhood, or who will not, on the day of testing, in or out of legislature or parliament, stand out irrespective of mere party politics or personal interest for the crying needs of the daily toiler in our mines or elsewhere. Honor to our ex-president, James Conmee, for the stand he took in the late sessions of our provincial legislature, and honor to faithful workers everywhere in the interests of the development of our young country. The day will come when the territory now embraced in this District of Algoma, will teem with millions of happy and prosperous people, nor is the time so distant as some would have us think. Germany is about twice as large as such a tract, and possesses no great natural resources, while supporting upwards of forty-five millions, besides having thousands of sons to spare each year.

Prominent in Algoma for all time to come, will be her stores of mineral, vast beyond conception. Her iron, her nickel, her copper, her gold and her silver will, under a liberal and enlightened mining policy yet be found, not only supplying her own growing wants, but also those of every land, in return for the treasures of other climes We stand to-day upon the silent hills, as prospectors, as pioneers, in a vast country, and can, it would seem, but little more than speak and think of a time when the chimney tops in the valleys and the hum of industry in our mines shall speak the more precise language of labor, of prosperity and peace. But as regards the duty lying next to hand, it is ours not to fail of its performance, and to strengthen the faith of our fellow-countrymen in themselves and in the land of their birth or adoption."

The Ophir Gold Mine.*

By W. R. Wallace, Bruce Mines, Ont.

The Ophir Mine has within the year just closing been prospected in the following manner:—One vertical shaft 95 feet deep to cut the incline or dip of the vein, which was reached at 90 feet when rich ore in vein of 12 feet in width was cut. One incline shaft to connect with this shaft was sunk 105 feet. Along the foot-wall of the vein which dips 45 degrees south, this entire incline was in rich ore and the values more as depth was reached; only one wall was exposed in the incline. The hanging wall was not reached. The cut is 7 by 8 feet all in good ore; above this and along the outcrop of the vein I have made four tunnels, the length of each as follows:—The first, or No. 1, is cut 50 feet; the second, which is 25 feet above this, is 80 feet in length with an uprise from the first for ore chuttles from dumps above; No. 3 is now 53 feet in length, and No. 4 85 feet, making 205 feet of upright cutting and 268 feet of drifting. In the drifts I have done no work, except on the pay streak, and this at the lower boils of the drift is 23 feet wide and narrows towards the surface to about 16 feet. The vein is thus exposed 578 feet in length and 230 in depth. I estimate 7,000 tons of ore on the dumps and 200,000 in sight on the pay streak alone, with twice that in ore that will mill $10 and $12 per ton. The mill runs made by Prof. Sharpless, of the Michigan Mining School, on 5 tons of ore from the pay streak, which I made as fair an average as possible, returned $46 per ton in free gold without the concentrates, which can be estimated to contain as much more value.

Our mill is now nearly completed, and by the first week in October we expect to commence milling in earnest, and hope to be able to run regardless of cost through the winter without interruption.

The mill has been carefully designed (with the latest patents for saving refractory ores), and I think it is one of the most complete plants in America, and as good as the best. I shall be pleased to report the results of its workings to your honourable body at any future meeting.

*Paper read before recent meeting of the Ontario Mining Association at Sault Ste. Marie.

MINING NOTES.

[From our own Correspondents.]

Nova Scotia.

Caribou.

The property formerly owned by the Lake Lode Company, now owned by Messrs. Gue, Wilson and others, is being reopened by Mr. W. A. Saunders under agreement. The water has been taken out to a depth of nearly 200 feet, and the shaft re-timbered and made secure. The lode will be opened laterally at different depths and tests taken therefrom. The property formerly was remunerative, and that under very bad management.

Brookfield.

Mr. John McGuire, formerly connected with the Molega Mining Co., is doing some work at the North Brookfield mine, preparatory to testing some new leaching process for extracting gold. The quartz from this mine has the reputation of carrying gold too fine to be saved by stamp mill amalgamation. The details and chemistry of the leaching process will not be made public until after the test.

Moose River.

It is rumored that Mr. Stephens and others will commence work on a block of unprospected areas in the 1st of October. The same rumor says rich float has been found.

Oldham.

The Standard property, owned by Taylor and Hardman, is keeping up its record. Several tons raised and milled in August yielded at the rate of 100 ozs. per ton. The output from this district for 1893 is expected to exceed all previous outputs.

The Columbia Company are still developing their property; a cross-cut being carried to the north to cut known lodes and a level is being driven to the westward on the Wallace lode at a depth of 100 feet.

Renfrew.

Mr. D. A. McDonald is reported to be getting average ore in the New Haven property. No quartz has yet been milled. The syndicate operating is composed of Pictou men.

Mooseland.

The reports from the Mooseland Company's property are good, the quartz gaining in value, and the lode holding its size.

Waverley.

The West Waverley Co. are running twenty stamps double shift, and report yields to be of average value for that mine, viz., 4 to 5 dwts.

The Tunnel Co. are working one shift, and report quartz showing well.

Quebec.

Lievres River.

Mr. J. Burley Smith, M.E., is conducting a series of tests with a Bullock Diamond Drill on the Ætna and Squaw Hill mining property of the British Phosphate Co. at Glen Almond. We understand that these have proved most satisfactory, locating deposits of phosphates which will pay to uncover. A contract to drive into one of these large bunches has been given and work is proceeding.

About 45 men are employed at the High Rock phosphate mine where the pits still look well. The deposits in pit No. 3, which a few weeks ago looked poorly, have come in again and show extremely well. A considerable quantity of low grade material continues to be ground at Basin du Lievres mill, whence it is shipped to the fertilizer works at Chicago.

Ontario.

The Ophir Gold Mining Co., Limited, operating in the township of Galbraith, about sixteen miles from the village of Bruce Mines, has its 20 stamps dropping and about 45 tons of rock are being put through the mill daily, but inasmuch as the retort and melting furnace are not yet complete, no clean-up has taken place. Much interest will be taken in the returns. The new mill building contains four storeys. The stamps have a weight of 850 lbs. and drop about 80 to the minute, being driven by a Corliss engine supplied by the Doty Engine Co., of Toronto. Eight fire vanners are used for concentration. About 600 tons of quartz have been raised this year and will be put through the mill as speedily as possible. A later mine test (to those given in Review some months ago) has been made by the Michigan Mining School of 1,125 lbs. of ore sent from the mine, with the following result: Silver, 1·80 oz. per ton; gold, 3·50 oz. per ton. About 30 men are employed under Supt. W. R. Wallace.

British Columbia.

Kaslo District.

Construction work is still being pushed by the C.P.R. between Nakusp and Slocan Lake, and a rumor is current that the owners of New Denver have given the railway 1,000 lots in that town, although as yet the rumor has not been certified.

Representatives of the Kaslo and Slocan Railway and of the Great Northern Railway are to meet in Spokane to-morrow, the 19th inst., with a view to the charter now held by the former company being sold to the G.N.R.

Since the 14th of August last there has been shipped 1,378,000 lbs. of ore from the Slocan mines, over 900,000 tons being shipped via the C.P.R., and the balance by way of Bonner's Ferry and the U. S. Returns, on the whole, show a higher grade of ore than previous shipments.

Considerable dissatisfaction is felt by some of the shippers owing to the way they have been treated both by the U. S. smelters and the railway company. They claiming a too great shortage in weight and an overcharge in previously agreed upon freight rates, besides considerable trouble with the customs. In consequence of this some of the shippers intend sending their next lot of ore to Swansea, Eng.

In the Noble 5 mine a wonderful rich strike has lately been made, the ore referred to being a tetrahidrite together with much soft decomposed matter, assays of which show that it will run over 1,000 ozs. to the ton, and the body is said to be unusually large for such high grade ore. The strike was made in the first discovered vein of galena.

Ore is being hauled to town daily but the road is reported in bad shape from the wet weather that has already set in and the loads are consequently light. Indeed little can be done with waggons in this country, but we have several months of first-class sleighing.

Prospectors have all been forced out of the mountains for this year by snow.

The Josephine Mining Company (Foreign), was registered at Victoria on the 9th instant. The company's authorized capital is $600,000, divided into 600,000 shares. Nelson is designated as the domicile of the company. Its promoters' names are not mentioned, neither is the location of its mines. The East Kootenay Exploration Syndicate, Limited (Foreign), was registered on the 5th instant. This is the company that acquired the Griffith-Galbraith hydraulic claims, on which quite an extensive plant has been placed, including electric light, so as to prosecute work by night as well as by day.

The government has decided that copies of all records of mineral and mining claims in West Kootenay shall hereafter be kept at Victoria, and with that object in view has sent Charles Hayward, Jr., up from Victoria to do the clerical work. Mr. Hayward left Nelson for New Denver this morning to make copies of the records at New Denver. Now, if the government will only have some competent clerk make copies of all records at Victoria relating to land in West Kootenay, and forward the same to Nelson, then create a registry district with the registry office at some central point, the people here would be accommodated, as will be the people of Victoria when copies of our mining records are kept for reference in that city.

A 40-ton shipment of ore has been made from the LeRoi mine in Trail Creek district to the Tacoma smelter. Work has been resumed on the War Eagle mine, in the same district, with "Joe" Morris as superintendent.

Two of the claims in the Grady group on Four Mile creek, Slocan district (the Alpha and Black Bear), have been bonded. The bond is for $70,000. A cash payment of $5,000 has been made, the balance to be paid in three, six, nine and twelve months. N. F. McNaught secured the bond for outside capitalists. Mr. Briggs, one of the three owners, was in Nelson to-day.

The Hall Mines, Limited, magnates have come and gone, and actual work has once more been resumed on what is likely to be one of the greatest mines in the world. The survey made for the tramway shows that the distance from the Silver King to the water front, a mile below Nelson, is little more than 4½ miles. The tramway will not be built until spring, as the plans must first receive the approval of the board of directors—and the board meets in London. Between 300 and 400 feet of shafts, crosscut tunnels, and drifts, will be run during the winter, which will give employment to forty-odd men. Additions will also be made to the quarters of the men and a shaft-house erected.

A shaft will be sunk on the Kootenay Bonanza; a drift run both ways from the winze sunk in the main tunnel; and a drift run both ways from the old shaft on the Silver King. These drifts will be started about halfway down on both the shaft and the winze. Most of this work will be done by contract.

Preparations are being made to ship a hundred tons of the ore now in the ore-house to Swansea, Wales; and if navigation holds out on the Columbia river, further shipments will be made. All the ore taken out this winter will be carefully sorted for shipment, which indicates that, for a time at least, the high-grade ore will be shipped to Wales.

(From the Miner.)

The Perry creek placers will be worked next season on a more extensive scale than ever before. A syndicate of English capital is said to have been formed for the purpose of giving the ground a thorough test. A great many thousands of dollars will be spent in wages and materials, and the people of that section consider the outlook to be more favorable than ever before.

Referring to the Silver King (Hall Mines, Ltd.), the *Miner* says: J. C. Yuill, and A. Findlay, have the contract for the tunnel on the big croppings. The temporary shaft on the Kootenay Bonanza is in the hands of Spencer and Bates. Cody and Landrigan have secured part of the drifting, and the remainder of it will be done by Mr. Conners. Robt. Yuill, the old foreman so long connected with the property will retain his position during the winter.

The tramway will not be constructed till spring, but Contractor Nelson of the N. & F. S., has decided to figure on the work, and will probably winter in Nelson, provided he got an ore contract to fill in the interval.

Among the moves contemplated for the immediate future is the making up of a trial shipment of ore. A big shipment of the best ore, carefully sorted, will be sent to Swansea, for experimental treatment. Upon the returns received from this shipment, will depend to a great measure, the construction of a matteing plant.

The Wild Horse creek district placers are said to have placed $27,000 to their credit as the gold dust production for the month past. A new town has been laid out on this creek at a point about three miles from Ft. Steele.

Miscellaneous.

At the recent meeting of the the newly organized Miners and Mine Laborers' Protective Association held at Nanaimo, the following officers were elected: President, A. Wilson; vice-president, R. Smith; Secretary, F. Wagstaff; financial secretary, J. Week; treasurer, W. S. Keith.

The Kootenay Hydraulic company took out seventy-two ounces of gold, which represents fifteen days' piping.

Deliveries of coal into San Francisco from British Columbia Collieries, for the month of September, amounted to 51,600 tons, or 50 per cent. of the coal received at that port during the month.

Respecting the discovery of a new gold field of great promise in the Alberni district, the *Colonist* has the following:

"Alberni will, according to present indications, be the centre of attraction next spring for gold seekers in this province. Reports from the few prospectors who have gone in there since the recent discoveries of rich quartz vary only in the details, for all agree that what has been found is good pay ore, and that the indications are that the veins extend over a much larger tract of country than is generally supposed. G. E. Jorgensen, the well known surveyor of this city, who has recently returned after two weeks spent in the Alberni district, is quite as enthusiastic as those who have already been heard from on the subject, and he has shown his faith—which is based on previous observations of gold quarts in other places—by associating with other gentlemen in the location of a promising claim which is to be worked in the spring.

"I spent two weeks up there," he said to the *Colonist* yesterday, "and the more I saw the better I liked it. There is no doubt that the veins are rich, and so far as has yet been ascertained they are continuously so. Certainly they extend over a large tract of country. My belief is that they can be found almost from one coast to the other on the island, and running as they do, north-east and south-west, they head straight for the gold country in Cariboo.

"It is surprising," he continued, "how skeptical the public have shown themselves about this matter, and I have heard people profess disbelief, for the most fanciful reasons or for no reasons at all, of reports which I know to have been absolutely reliable. Of course no actual working results have yet been obtained, because there has not been time, but next season there will assuredly be several mines in active operation. Ours will, for one. I have heard that English capitalists have secured an option on one of the most promising properties, and it is their intention, if they conclude the bargain, to lose no time in getting to work.

"Until recently no one gave a thought to quartz mining in this country, placer working being all the rage, and thus it happened that these rich deposits which crop-

ped out and were talked of in several localities received no further attention. I was told of one discovery made a long distance from the scene of present operations, by gentlemen from the neighborhood of Duncan's, who, after locating a claim, allowed their title to lapse, simply because everybody, knowing nothing about the value of the ore, said that there would be no money in quartz mining. These gentlemen have recently come to a different conclusion, and will again stake their claim, which, fortunately for them, has not been taken up.

"The country is a difficult one to prospect in, but once a vein is struck it can be followed without difficulty, and the general situation is such that tramways can be constructed without abnormal expense, to take the ore down to the sea coast for transhipment to the smelters. The proximity to the coast is one great advantage that this country has."

CANADIAN COMPANIES.

Bootanie Creek Gold Mining Co.—Applicant for charter under British Columbia Companies' Act. Capital $150,000, in shares of $100 each. Head office: Vancouver, B.C. Trustees: Walter H. Kendall and Samuel Knox Twigge, Vancouver, and Duncan H. MacPherson, High River, Alberta, N.W.T. The new company is being formed to acquire and work mineral claims at or near Bootanie Creek B.C.

Hamilton Iron & Steel Co. Ltd.—Applicant for charter under Ontario Statutes. Capital, $1,000,000, in shares of $100. Head office: Hamilton, Ont. Directors: J. Jennings Moorehouse, New York; Wm. Van Veghten Reynolds, Reynoldsville; Wm. Foster, Jr., New York; Ed. Harris Thompson, Millerton; Herbert Nelson Curtis, New York; J. Henry Tilden, Hamilton; John Milne, Hamilton, and Robert Jaffray, Toronto. Formed to mine lands and operate mines in the Province of Ontario. Operations are in the County of Wentworth.

East Kootenay Exploration Syndicate was registered under the Foreign Companies' Act, (B.C.) at Victoria, on 5th October. Capital, £80,000, in shares of £1 each. The places of business of the Syndicate in Canada, is at their mines, Wild Horse Creek, East Kootenay District, B.C.

Wycott Hydraulic Mining Company has been formed to take over, purchase and acquire a certain mining lease or leases, dated the 4th July, 1892, granted to James M. Harvey and Thos. J. Trapp, of New Westminster, B.C., and the water privileges in connection therewith; and to carry on the business of hydraulic or other process or processes of mining. Capital $500,000, in 50,000 shares of $10 each. The five Trustees are: S. K. Twigge, John Twigge, J. M. Spinks, M. M. Hirschberg, of Vancouver, and Thos. J. Trapp, of New Westminster, B.C. Head office is to be at Vancouver.

Tobique Valley Gypsum Mining & Manufacturing Co. Ltd. has been formed under Dominion charter with a Capital of $50,000, in shares of $100, to acquire and work Gypsum lands, in the Province of New Brunswick, and elsewhere in the Dominion of Canada, and to manufacture land plaster and other fertilizers. Head office, at Ottawa. The incorporators include the Hon. John Costigan, Secretary of State; G. P. Brophy, Ottawa; John Heney, Ottawa; Hon. H. G. Connell, Woodstock, N.B., and Henry A. Costigan, Winnipeg.

MANUFACTURING NOTE.

New Works of the Robb Engineering Co.

The works of the Robb Engineering Co., Ltd., which were swept by fire August 28th, 1890, have risen Phœnix like, till now this enterprising company is employing as many hands as before the fire, and when it is remembered that they have given up the manufacture of stoves altogether, only making the repair pieces, it will be evident that they are now pushing their engine and boiler business, machine work and hot air furnaces more extensively than before the fire. They employ 100 hands to whom they pay out a weekly sum amounting to $2,500 to $3,000 per month. They have lately moved into a large and well equipped brick moulding shop, which is 100 feet square and is fitted with two large swinging cranes for heavy work, patent Colliau cupola, large brick core oven, etc. Their boiler shop is 100 x 50 ft. and is fitted with overhead travelling cranes, besides a good outfit of boiler shop machinery. Their machine shops are 100 x 40 ft. (two flats) and are fitted with the best and latest machine tools for building high speed engines, heaters and power pumps, which they supply with their steam plants, and for doing general machine jobbing of all kinds. In addition to these shops, they have a large salesroom in which they carry a heavy stock of supplies, such as beltings, hose, packings, oils, iron pipe and fittings of brass and iron, etc., also engineers and sawyer's tools of every description, and in their commodious offices and drawing office are to be found every modern convenience. Their specialties are the Robb Armstrong engine, which is considered by competent judges to be the best engine yet introduced into Canada, and fully equal to the best produced in the United States, having all the parts interchangeable and embracing the best points in the leading American engines, also the Monarch Economic boiler, which not only gives very high economy, as its name suggests, but it is portable and has many other good points. These steam plants outfitted with heaters, and steam or power pumps of the latest design, they are sending to Ontario, Quebec and the North-West.

In proof of the foregoing it may be stated that they have placed one of their compound engines in Windsor, Ontario, which is running splendidly, and they have lately shipped one to Lethbridge, N.W.T. Twelve of these engines have been placed in Montreal alone, besides other places in Ontario and Quebec. Three of the Monarch Economic boilers were shipped for one plant alone, viz.: that of Windsor, Ontario, and the last of three more for London, Ontario, was shipped last week besides those that have been placed in Montreal and other places. In addition to these steam outfits they of course still supply sawmill machinery of all kinds.

Electrical Safety Apparatus for Cages—A description of an electrical safety apparatus for mine cages is given by Mr. J. Yates (Transactions of the Federated Institution of Mining Engineers, vol. ii., pp. 362-68, three plates). The requirements of a safety apparatus for mine cages are that it should never fail to act when required, and that it should not act unless the rope breaks; it should allow of being tested; it should be simple, and should not interfere with ordinary work. The apparatus consists of weighted levers, which are normally held out of action by horseshoe magnets, but which grip the guides through the medium of cams when liberated. A continuous current is used to keep the magnets excited, and this current is led to the magnets by two copper wires laid in the hemp core of the winding rope. The connection between these conductors and the battery is made by two brushes working on two copper rings on the drum shaft. This method of conveying an electric currrent to the cage has been successfully in use for some years for signalling purposes in the Durham district.

An illustration is given (*Electrical Review*, vol. xxix, p. 609), of a winding indicator worked by worm gearing from the drum shaft. Electric contacts are arranged on the dial, so that the pointer completes an alarm circuit when the cage is near the end of its travel, and thereby sounds an alarm bell. As the cage descends, the pointer lifts a spring and avoids making contact. The contact pieces are clamped in position by set screws, so that their position can be adjusted to suit the winding.

The Behaviour of Coal during Combustion—Mr. B. Holgate (lecture delivered before the Yorkshire College Engineering Society, December 7, 1891, through the *Colliery Guardian*, vol. lxii., p. 1014), described the variations of the behaviour of coal during combustion. Cannel coal contains a considerable quantity of fish remains, and was deposited under water. When coked, the lumps retained their original shape. Most other coals are somewhat similar in composition to one another, so that analysis alone will not determine their burning qualities. The appearance of the coal is a much better guide. Some coals require a high temperature and a strong draught to burn properly, such as the Better Bed coal of Yorkshire. As a general rule, coal which breaks naturally into small pieces will not deliver its gas so freely and will not burn so rapidly, but it makes the best coking coal when it is soft and breaks up easily. When the coal breaks into large lumps the gas can get away more readily.

The Manufacture of Nickel-Iron Alloys—Dr. H. Wedding (*Verhandlungen des Vereins zur Beforderung des Gewerbfleisses*, 1892, pp. 52-65), refer to the results of Riley's examination of the nickel-iron alloys. With regard to their mode of preparation, they may be made in blast furnaces with a mixture of oxide ores of iron and of nickel. The metal produced in this way is high in carbon, and is not suitable for conversion into malleable nickel-iron poor in carbon. On puddling such a carbon nickel-iron, oxides of nickel are formed, which are dissolved by the metal, and render it brittle to a much greater degree than would dissolved oxide of iron. To make a malleable nickel-iron alloy, metallic nickel must be added to the molton malleable iron. Nickel and iron do not form true alloys by themselves, but only mixtures, and to render these mixtures homogeneous some third metal, such as aluminium, must be added. Such experiments as have been from time to time recorded, which relate to the alloys of nickel and iron having far from exhausted the subject, the German Society of Arts is about to undertake a further and more detailed examination of these alloys. Viewed from the results of Riley's experiments, it would appear that the alloys best fitted for general use are those with less than 0.3 per cent. of carbon, and the percentage of nickel should not exceed about 5. What percentages of these two elements in the alloys are actually the best in the whole series has not as yet been shown, and information is wanting as to the real mechanical properties of the best of the alloys, and how they should best be handled. This too will form the subject of the investigation referred to.

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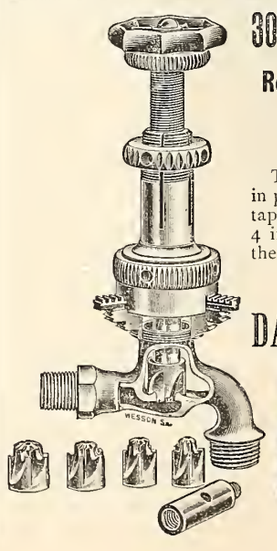
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GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

SOME REMARKABLE RESULTS IN GOLD EXTRACTING.

New York *Sun*, Sept. 12.—"The Crawford Gold extractor, which was recently put into the Richmond Hill at Hillsborough, New Mexico, is giving satisfaction. It has been tested on runs of ores from different mines in the district with uniform good results."

Salt Lake *Times*, Aug. 28.—"Mr. Woodman came in from Deep Creek yesterday, where he has been for a month or six weeks, and he pronounces the Crawford mill a perfect success, saying that since the mill started it has saved 92 per cent. of the assay value of the Gold Hill ores, some of which are very rebellious."

John C. Smith, Supt. of the Ogema Mining and Smelting Co., says: "It gives me great pleasure to add my testimony in favor of the Crawford mill in every way, as to its 'gold saving qualities,' 'practically no loss of mercury,' 'small volume of water required per ton of ore,' great ease of manipulation,' also as to its portability to mines remote from railroads, and 'ease of setting up ready for operation.'"

L. J. Boyd, M.E., Supt. Montagu Mines, after personally supervising a test on arsenical ore says: "The results were simply wonderful. I am personally perfectly satisfied with this system of ore treatment, and should advise its adoption, as the experiments were carried on by my personal superintendence. Similar ore was treated by the Montagu stamp mill showing a difference of 100 per cent. in favor of the Crawford mill."

Fredericksburg, Va., *Free Lance*, Sept. 6.—"L. G. Johnston, of this city, in an interview, said he sent to the M.G.E. Co., N.Y., one ton of very low grade sulphuret ore from the mines of the Powhattan L. &. Mining Co., Culpepper Co. He went to New York and personally witnessed the working of the ore. The results of ten different samples of ore, averaging in assay value from $2.13 to $7.35 per ton, showed a saving of 88 per cent. of the value by actual mill run, this without the use of chemicals or fire. These results were so satisfactory that a large sized mill will be placed on the property at once."

W. D. Sutherland, Secretary of the Salisbury Gold Mining Co., of Nova Scotia, after having over 4 tons of ore treated by the Crawford mill, says: "Sample of the tailings taken during the run showed by assay an equivalent to 0.033 oz. to the ton. This evidence of the capability of the Crawford mill to extract all but a trace of the gold which the ore may contain must be considered of importance by all who are interested in the question of improved methods of milling gold from the ore. The test alluded to was made under the supervision of our company through trustworthy agents."

THE CRAWFORD MILL WORKS MORE CHEAPLY,

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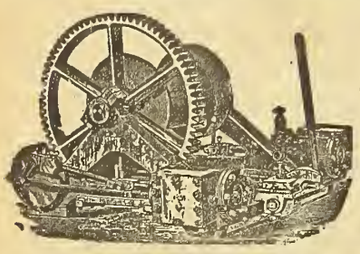

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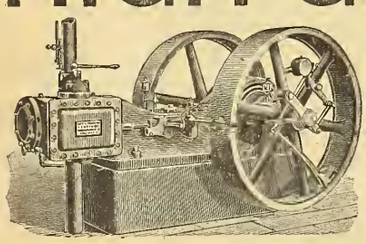

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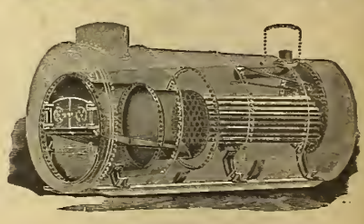

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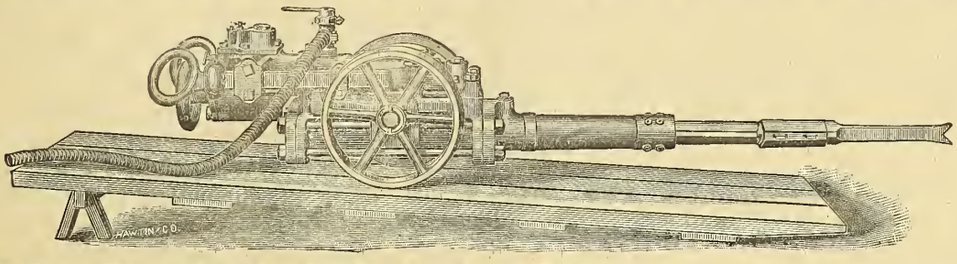

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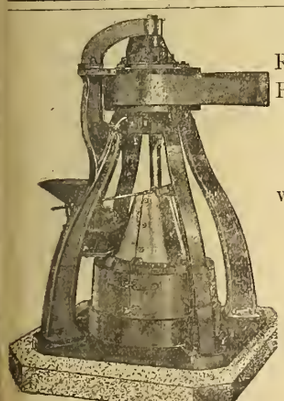

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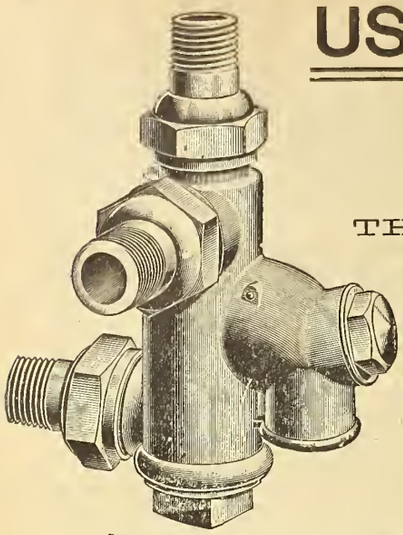

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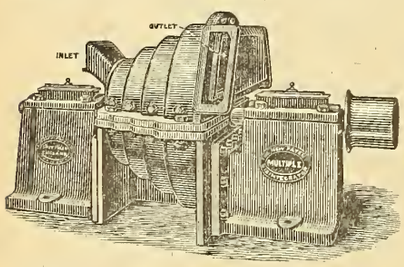

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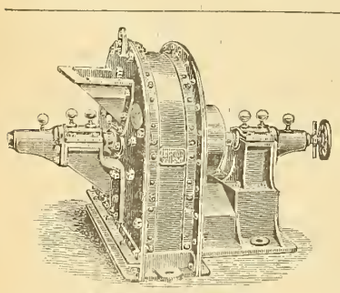

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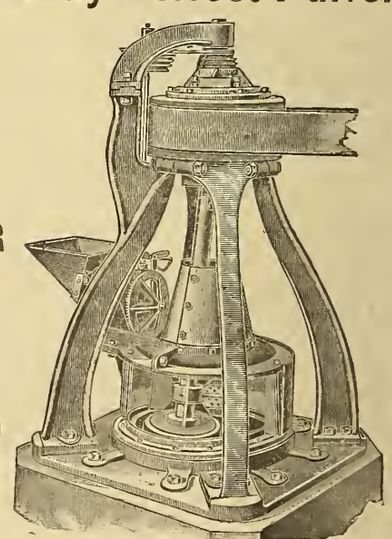

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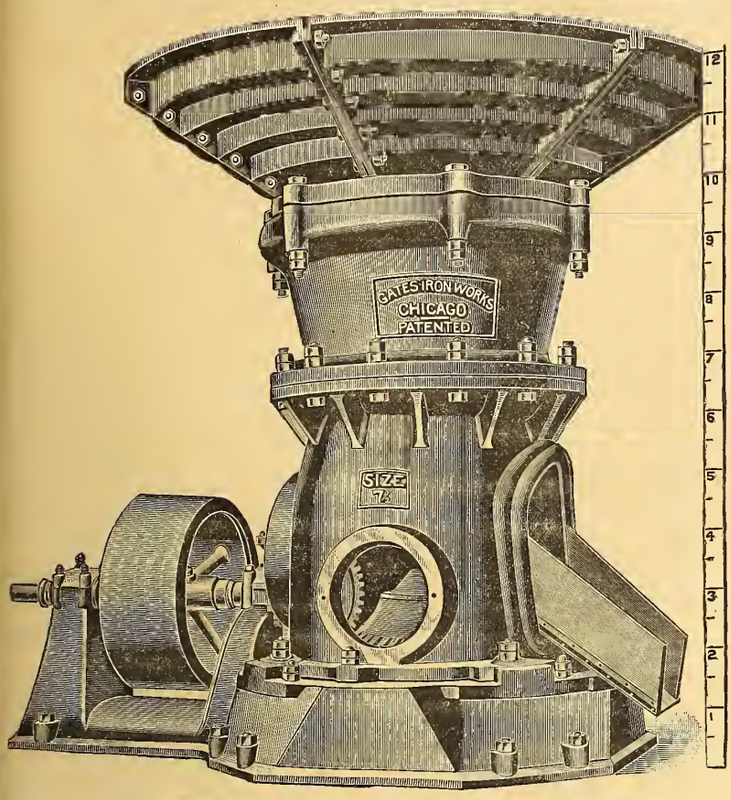

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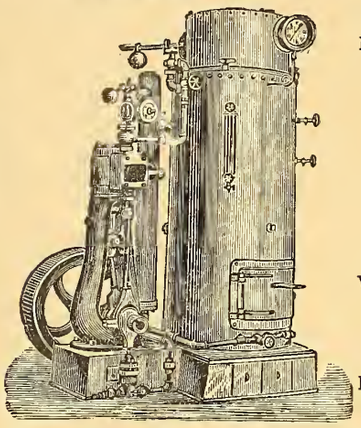

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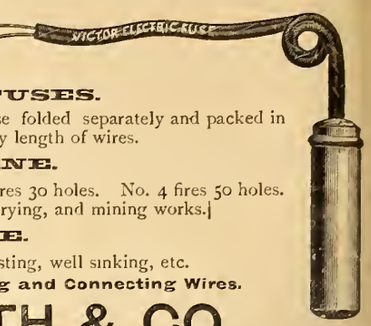

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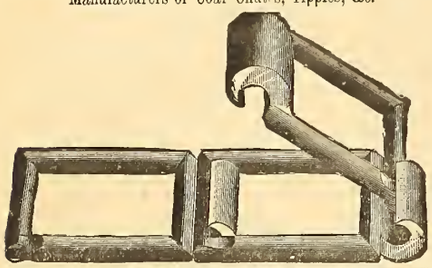

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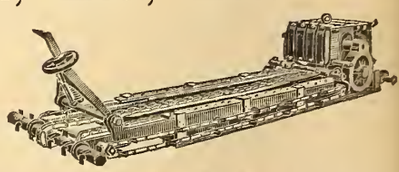

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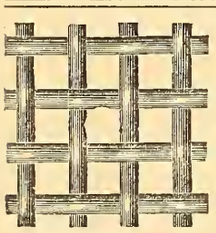

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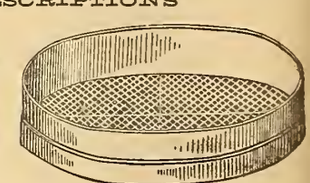

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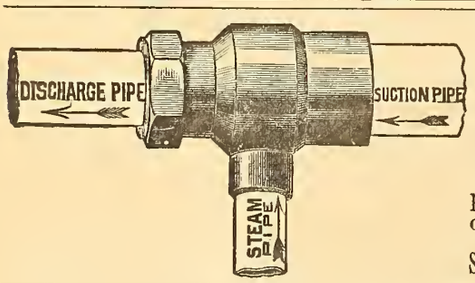

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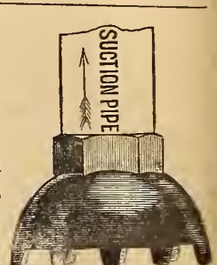

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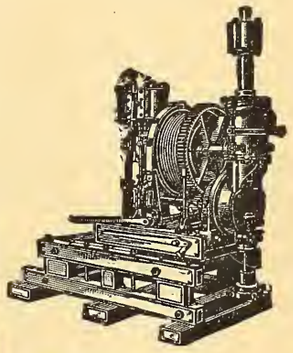

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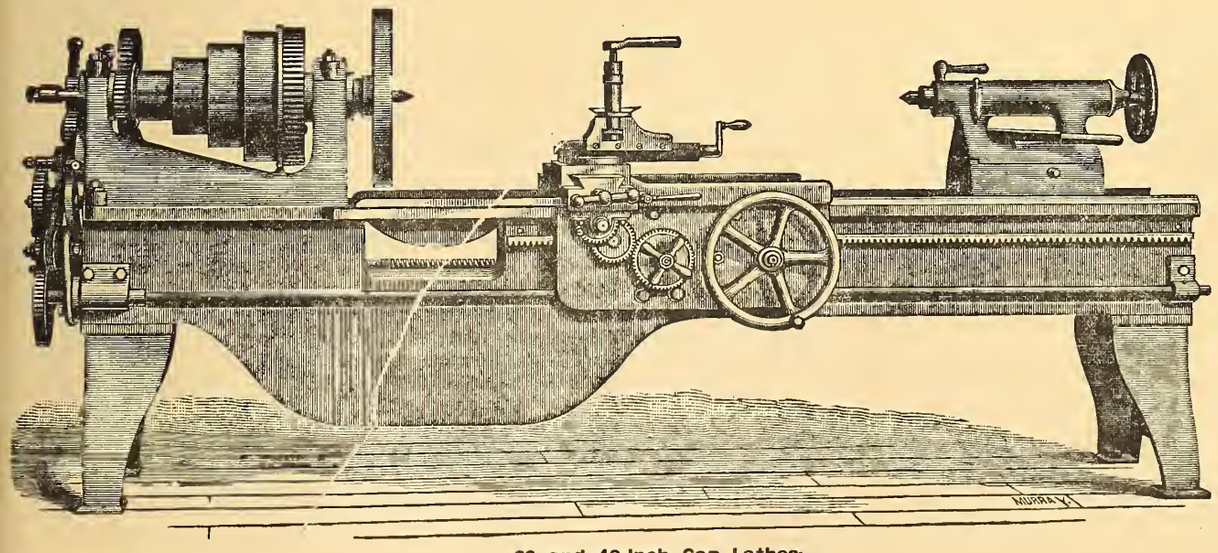

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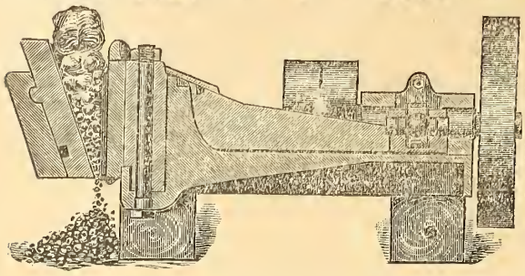

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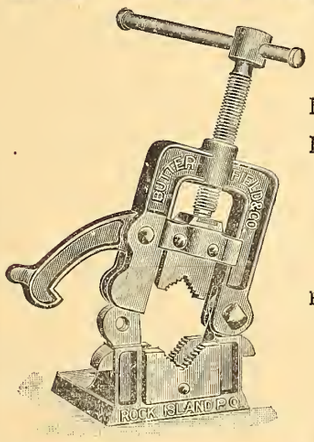

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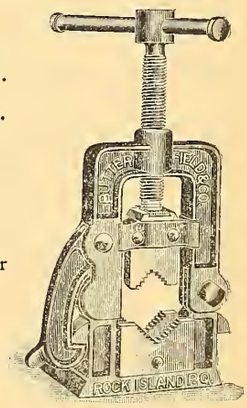

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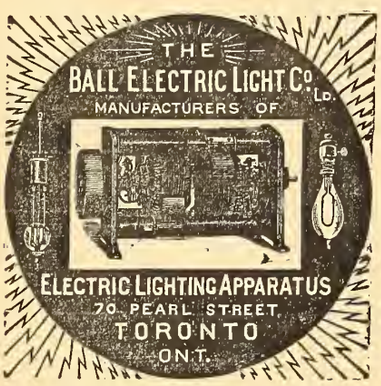

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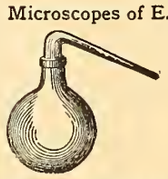

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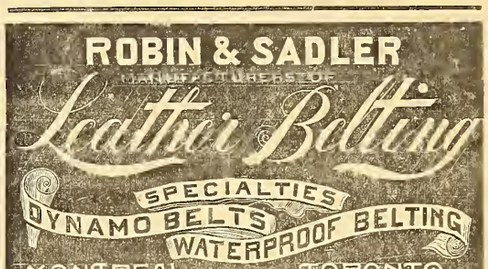

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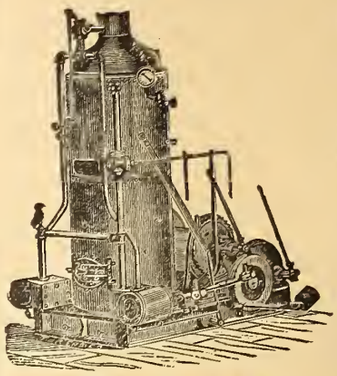

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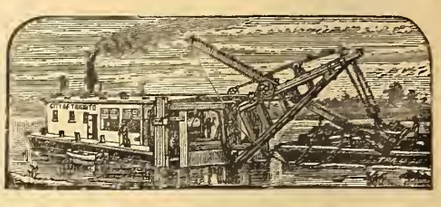

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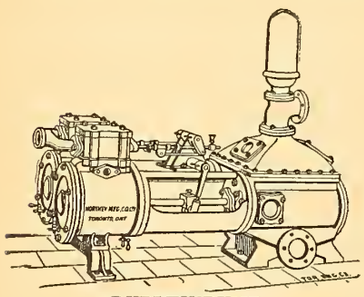

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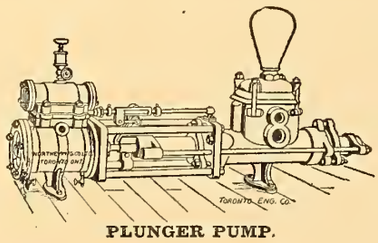

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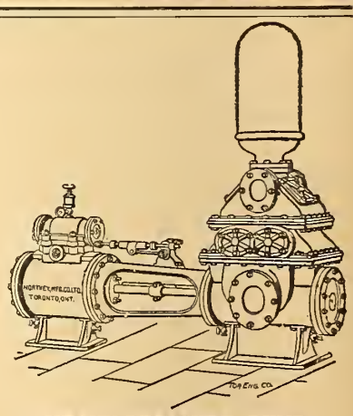

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Vol. XII. NOVEMBER, 1893. No. 11.

THE OFFICIAL ORGAN
—OF—
THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,
THE UNITED MINING SOCIETY OF NOVA SCOTIA,
THE ASBESTOS CLUB, QUEBEC,
THE GENERL MINING SSOCIATION OF QUEBEC.

The School of Mining at Kingston.

The report of the Royal Commission on the mineral resources of Ontario in 1890 touched strongly on the desirability of increased educational facilities for those who desired to undertake mineral and metallurgical development.

The Commission not only favored a school of mines at an educational centre, but they pointed out the excellent results that had been obtained in New Zealand by giving facilities for the acquisition of knowledge to prospectors, mine foremen and others interested in mineral development through the medium of short special courses of instruction.

The Ontario Government was impressed by this portion of the Commissioner's report and adopted a policy of giving assistance to any School of Mines who convinced them that they could raise the means to assist themselves.

Principal Grant of Queen's University, with his usual sagacity and activity, at once saw the opening which existed, and interested a number of gentlemen in eastern Ontario, with the result that the school has been established at Kingston under a strong individual Board of Governors.

The board is composed of such men as Mr. J. B. Carruthers, of Kingston (chairman); Mr. E. W. Rathbun, of Deseronto; Principal Grant, Messrs. Hiram A. Calvin, M.P., Wm. Harty, M.P.P., James Swift, G. M. Macdonnel, Q.C., C. F. Gildersleeve, M. F. Folger, J. L. Whiting, Geo. Y. Chown, all of Kingston, and Mr. Jas. S. Haydon, of Centreville.

The course which has been laid by the school for the degree of Mining Engineer (M.E.) will occupy four years, and it includes every subject which is necessary to a thoroughly qualfied "expert."

Chemistry is taken up by Dr. Wm. L. Goodwin, F.R.S.C.; mineralogy, metallurgy and assaying by Mr. Wm. Nicol; geology and petrography by Mr. Willet B. Miller, B.A.; mining by Mr. Wm. Hamilton Merritt, F.G.S., who was one of the Commisioners on the above mentioned Royal Commission; engineering by Mr. R. Carr Harris, C.E.; mechanical or office drawing, etc., by Mr. William Mason, and the laboratory demonstrators are Messrs. T. L. Walker, M.A., and Dr. Isaac Wood, M.A.

The school has commenced its career not only with a very complete faculty, as above set forth, but its laboratories and facilities for giving the student practical demonstrations of the subjects are already very good, and as means are acquired these will from time to time be added to.

With regard to the special short courses of instruction we cannot do better than quote from a recent editorial in the *Globe* which in speaking of this School says: "Besides providing for all the studies which will be necessary to entitle a graduate to put M.E., after his name, arrangements are made for the attendance of occasional students, to give opportunities to persons who do not intend following engineering as a profession to receive the benefits of courses likely to be useful in common life.

It is not at all improbable that this part of the work of the School may prove at first to be its most useful feature. The most important class in an unexplored mining field is that of the prospectors—the hardy, enterprising fellows who, at the expense of great privations, add by their investigations to the wealth of the world. Their knowledge of minerals is in the main empirical, and it would be a distinct advantage if it had a surer scientific basis. How much disappointment and how many broken hopes have been due to imperfect knowledge, and how much toil has been expended on places that the merest smattering of geological lore would have avoided, it is hard to estimate. Certain it is that few prospectors but could furnish their quota of experiences in this line."

The short special course begins January 9th, 1894.

Every Man to his Trade.

We have received the full working details of a metallurgical process which is the invention of, and has been patented by, Admiral J. H. Selwyn of the British Navy, also a copy of the lecture which that gentleman delivered on the subject before the San Francisco Academy of Sciences last August. Admiral Selwyn is a brother of the distinguished director of our Canadian Geological Survey.

The Admiral, in this process, not only treats us to a new metallurgy, but to a new chemistry. He sets out by informing the public that this process "will extract the metals and the metalloids by a single treatment from their ores, no matter how refractory," and at a cost of about 10s. per ton. But as this process (?) has been known (more or less) since 1887, it is remarkable that no one has yet adopted so cheap a process as one that costs but $2.50 per ton treated. The fact of the matter is that the whole so-called process is so ludicrously wrong in its chemistry that the only object served by taking notice of the matter at all is to notify the mining public generally to avoid new processes until examined by competent experts. As an example of the Admiral's chemistry we give a few of his equations for the delectation of our chemical readers:

(1) $H_2O + 2Cl = 2HCl + O$.

(2) $S_2Cl_2 + H_2O = H_2SO_4 + HCl$.

(3) $NaCl + H_2SO_4 = HCl + NaH_2SO_4$.

More of such equations are given, and for such of our readers as may feel interested we refer them to the issue of the *Mining and Scientific Press*, San Francisco, for Sept. 2nd, 1893.

In these days of rapid metallurgical progress, and equally rapid dissemination of so-called "Popular Science," it is perhaps to be expected that tyros will rush in where experts fear to tread. The patent offices are full of processes, some based on chemistry, some based on nothing, that exhibit heights of absurdity and abysses of error that are simply appalling to the metallurgist.

The rapid progress of the cyanide process in South Africa, where the conditions of the ores are most favorable for its successful operation, has stimulated others to evolve processes out of their coagulated brains, and to flood the mine owner's mail with circulars and pamphlets that claim extraction to the very verge of plus 100 %. An old rule of Emerson's regarding books—to read no new work until it had been published a year, when if it were still selling it would be worth reading, but if not we had lost nothing by not reading it—might very well be changed to apply to metallurgical processes, if authenticated successes in practical working cannot be adduced, leave the process severely alone.

We have been constantly surprised at the number of patent amalgamators, pulverizers, mills, processes and appliances that were going to revolutionise modern metallurgical methods, but have sunk into oblivion speedily and forever.

One maxim may be taken to heart by our mining friends, which is, that the progress of metallurgical art is towards the sub-division of the work to be done, each part being perfected by itself, rather than towards the the evolution or discovery of any one machine or process that can perform the whole work in one operation, and this is particularly true of gold metallurgy, into which the distinguished admiral has strayed.

"When an admiral meddles with chemistree,
"He's just where an admiral ought to be—
"All at sea."

Examination Mad.

Nova Scotia has long been the happy play ground of the ideal statute menders, but of late it has excelled even itself. Its fertility in this way has thrown up examination stalks of strange growth within the last few years, and from one has burst into being an extraordinary blossom. To appreciate this *lusus naturæ* it is necessary to explain that the mining law for years has required that the drivers of engines, with those in charge of gins and windlasses, shall be 18 years of age at mines where men are hoisted. New regulations have required such men to be certificated after examination; examiners were appointed and examinations held. With the unfolding of

the bud and the publication of the questions the pearl that it contained has been exposed to the vulgar gaze. The unpretending laborer on a windlass has been dignified among the ranks of engineers—from a being without cares outside his immediate surroundings he is to be taught to abstract his mind from the dangers of the man in the bucket below him as he bends over the crank, and he is expected to work out mentally the error in the height of the neighboring colliery chimney, the quantity of water necessary to condense the steam he sees escaping from the engines, to find the safe working pressure of boilers, the capacity of certain pumps, and similar light and airy nothings relevant to his calling. In the meantime examination's victim, in the bucket, has reached the surface and the mentally abstracted student at the crank has pinched his fingers on the rope-roll. We are not surprised that the Stellarton *Journal* asks for criticisms on the questions, and we await with interest the expressions of opinion its enquiry may produce.

15,000 Tons of Asbestos in Sight?

We have been favored with the prospectus of the International Asbestos Mining and Manufacturing Company (Ltd.), which has been formed under the laws of New Jersey, to acquire and work an asbestos property containing 130 acres of asbestos bearing land in the Township of Denholm, County of Ottawa, Que. From the report of H. C. Woltereck, Ph. D., a New York chemist and consulting mining engineer, we learn that :—

"The amount of rock taken out of the different veins and openings is taken by a very conservative estimate to be about 35 tons, which contain two tons of asbestos of different grades equal to 5⅝ per cent. of the rock mined. The grade of the asbestos mined distributes itself about as follows :

First quality,	¾ inch and longer	12 per cent.
Second "	½ to ¾ in. and longer	28 "
Third "	shorts	60 "

The amount of asbestos *in sight* is estimated at about *15,000 tons*. This calculated yield should pay on estimated percentage of grades the following prices, $150, $60 and $30 per ton respectively ; $270,000 for first quality, $252,000 for second quality, $270,000 for shorts, or third quality, total $792,000, of which deduct cost of mining and other expenses $20 per ton, or $300,000, leaves a net profit of $492,000."

From all of which exaggerated notions it is quite evident that Mr. H. C. Woltereck, Ph. D., has much to learn regarding the asbestos business. Admitting for the moment that the mineral exists in quantity on the property in question, which we gravely doubt, it would be interesting to know in what market he is going to realize the fabulous prices he quotes for such short-fibred stuff, and on what basis he computes his estimate of working cost. Mr. L. A. Klein, M. E., General Manager of the American Asbestos Company, an experienced and undoubted authority says (see paper read before the General Mining Association of Quebec) :

"I am of the opinion that as a rule the quantity of rock mined to the ton of asbestos is greatly underestimated. Basing, on the capacity and actual work of our machinery appliances, the known quantity of lorry loads removed from a mine during a year, and the known average weight of each load, in relation to the totals of asbestos produced, I hold that one ton of asbestos to 100 tons of rock is a fair average. If we accept this, the cost of production of asbestos may be set down as follows : drilling, 3½ cents; blasting, 3 cents ; labor for removing rock and gathering asbestos in the pits, 25 cents, making a total of 31½ cents to the ton of rock, or $31.50 to the ton of asbestos ; $7 for cobbing, $1.50 for bags and bagging, 50 cents for loading, $5.50 for supplies, that includes fuel, tools, iron, steel, timber, other material and repairs, $6 for general business expenses, such as management, insurance, offices, marketing and others, $3.75, 10% wear and tear, calculated on a total of $355,000 in plant and 9,000 tons production, making a total of $55.75 to produce one ton of asbestos. If we calculate now that we have to pay interest on a total invested capital of about two and one-quarter millions of dollars, for which at least 10% must be expected, we have in our sales to average a price of at least $80 per ton of asbestos."

A few years ago the Templeton Asbestos Company (Limited), paid $125,000 for a property in the same county containing exactly the same short-fibred asbestos, and although $20,000 were expended in development at a time when prices were much higher than to-day, they were compelled to close down and the mine is now in the hands of the Receiver. It cost that company, under the most careful and economic management, exactly $85 per ton at the mines, to which had to be added the cost of crushing and separating the material and cartage to the mill, an additional $10 per ton, or in all $95 a ton. In two years working, the asbestos and serpentine sold did not realize enough to meet working expenses. Perhaps if Mr. Woltereck will apply to the management of that concern he will receive some much needed enlightenment on the strong improbability of a working profit to be derived from the Denholm property. In the meantime investors are warned to accept with caution the highly colored and wholly erroneous statements he has made, and the opinion of some competent authority on the asbestos business should be obtained before contributing their quota to the 1,000 shares of very doubtful stock now offered for subscription.

EN PASSANT.

We have frequently referred to the dormant wealth and abundance of the iron ore deposits of Ontario and the various aids and suggestions to bring about their utilization and development, but the hard fact still remains that in spite of a protective tariff of $4 per ton and a bounty of another $2 per ton, this province does not produce a single ton of pig iron to supply her own demands, but continues to pay heavy tribute to foreign labor and foreign sources of the raw material. The contemplated revision of the mode and extent of taxation in the United States, has given a gleam of better prospects in store for these mineral resources, and prospectors and owners of iron-ore claims are anxiously looking for a material reduction if not an entire abolition of the seventy-five cents duty per ton now existing on iron ore entering the American territory Perhaps no portion of the Dominion possesses such an extent and variety of iron ores as that comprised between Lake Ontario and the Ottawa River, which is at the same time conveniently served by rail and water ways permitting the transportation of our ores to the American blast furnaces in Ohio and Pennsylvania, and a reduction of fifty cents upon the present United States tariff, would undoubtedly not only revive the operations that formerly existed in the iron ore working, but promote a great activity in new enterprises and developments. It is an anomaly that an augmentation of half a dollar or seventy-five cents per ton in the market value should suffice to inspire investors, while the Dominion bonus of $2 per ton on the domestic production of iron fails to encourage the establishment of a single blast furnace, and the only apparent explanation is our lack of confidence and technical skill necessary to successful iron smelting. However this may be, the next best thing to utilizing this dormant wealth of iron for our own requirements, is to employ Canadian capital and labor in its extraction and transport.

As mentioned in our mining notes an enquiring movement is showing itself in gold mining in the Hastings county, Ontario. The discovery of gold in this region dates from the autumn of 1866, and for a few years very active researches were carried on. Several mines were rapidly opened up, proving the auriferous nature of the veins over the zone of rocks to the west of the Moira River. Further research and discoveries have shown the extension of the gold rocks into the townships of Belmont, Madoc, Elzevir, Kaladar, Methuen, Lake Tudor, etc., comprising an area of some 1,200 square miles. Vennor, who was the first to examine these deposits, assigned to them four different modes of occurrence which would appear to demand careful discrimination in order to select those deposits of most economic importance. The associated minerals also are seen to vary with certain belts and geological horizons, so that the suitable process for successful extraction of the precious metal may change with the locality. Arsenopyrite or mispickel is the characteristic sulphuret accompanying the richer deposits, and to its refractory behaviour by amalgamation, may be chiefly attributed the failure of former efforts to secure the assay value of the ores. Modern improvements in gold extraction methods, notably the perfection of concentrating machines, and the wonderful results attained in South Africa and elsewhere with the application of the cyanide lixiviation process, justly encourage the resuscitation of gold working in the Hastings county, and other refractory ore regions.

Referring to that portion of Ontario mentioned in the preceding paragraphs, we are reminded of the great necessity of a better knowledge of its superficial geology, and by looking over the Reports of the Geological Survey of Canada, we find that a very considerable amount of time and money has been expended precisely on the

region in question, but of which no corresponding report has been made public. According to the Summary Report of 1884, Mr. E. Coste and a topographical surveyor were engaged from the 1st May to the 25th October in a detailed examination and micrometer survey of Rawdon, Huntingdon, Madoc, Marmora, Wollaston and Belmont, embracing 350 square miles, the published report of this work is given in a resumé of thirty-four lines (page 7A Report 1885). During 1885 Mr. Coste was assisted by two topographers, Mr. Vautelet and Mathewson, and continued his examination of Hastings County, extending them into the Counties of Peterborough and Victoria; his resumé of 30 lines is all that was made public of this season's work. In 1886, Mr. Coste continued his third season's work of the same region with the assistance of Mr. J. White as topographical surveyor, and we find 28 lines from him on page 21A of the Report for that year. But we are informed in Dr. Selwyn's report, p. 20A, that a map covering 700 square miles on a large scale had been completed, and further that "the detailed report on the Madoc and Marmora region, may not be ready for publication for some months, though it is anticipated that it will form a portion of the next annual volume." Mr. Coste eventually resigned his position in the Geological Survey in March, 1889, but neither the map of 700 square miles nor his report of the result of three years' time and money has been published, and the only souvenir to be found in the publications of the department beyond the few lines in the annual summary reports of Dr. Selwyn, is a geological map of part of Madoc and Marmora, comprising 100 square miles, issued in 1887, without any report of reference. Is it possible that the information derived from the three seasons' work of Mr. Coste and his field staff, and carried out at considerable public expense, is now entirely lost to the public weal? Has Mr. Coste appropriated all the material and notes of the work, and if so is he right in so doing, or is this only another instance of the peculiarly shiftless and unsystematic methods that characterise the publications of this branch of the public service.

One of the greatest evils afflicting the gold-mining industry is the plundering from the mines or the reduction mills by employés. In the early days of gold mining in Nova Scotia the peculation of rich quartz in the mines was notorious and old mining captains can give examples of the dishonesty which has surrounded them while working rich ground. The general view among a certain class of miners is that a mine is a milch cow, which should provide them with a means of support outside of their wages. But the law is strict and offenders who have been caught have been invariably everely punished. A few months ago we instanced the case of the Oldham Gold Co., from which amalgam and plates to the value of $700 were stolen and where the thieves were sent to the penitentiary for three years. A year ago a highly sensational case of gold stealing was disclosed in the United States, but this has been eclipsed in Australia by an example of thieving almost without a parallel in the history of this industry. The victims have been the shareholders of the Mount Morgan mine, which owing to the extraordinary character of the gold formation, the sensational yields, and the immense sums spent on experiments have rendered it famous all the world over.

For a long time the directors of the company entertained suspicion that gold was being stolen, but they had nothing more tangible to go upon than the fact that for many months a number of men in the employment of the company, who were earning wages of from £2 to £3 per week, were known to spend regularly sums considerably in excess of that amount. For months the directors made every effort to discover the thieves, and quite three months ago they had facts in their possession which pointed very directly to one or two of the men who have since been arrested, but the essential links were wanting. Until these were found it was thought highly injudicious to attempt any arrests. Gold was stolen in many forms, but all from the one department. Charcoal was stolen from filters, as also the residuum as it fell from the turning off; amalgam was likewise stolen. A number of estimates have been made as to the extent of the total loss, but these are more or less conjectures. The latest, and probably the one most likely, puts the amount down at between $100,000 and $150,000. All big parcels of gold were sent away, some to Sydney, some to Charters Towers, some to Clermont, in fact to every goldfield in the country where there was a possibility of disposing of it without detection. Very considerable ingenuity and skill were shown in disguising the gold. It was alloyed with base metals, and by some particular process in which salt and water are largely used was so changed that it was made to appear like alluvial gold, and was sold as such.

The story of the detection of the robbery is full of interest. It shows how detectives were got up from Brisbane, and how they failed to discover anything. When these men came to the mine they were given situations by the principal officials who were aware of their true mission; but although nothing was found that would warrant public proceedings being taken, the directors bit by bit gathered information of great value, and two or three months ago they knew that some of the men now in custody were systematically stealing gold, and receiving it knowing it to have been stolen. They then resolved to proceed with much greater secrecy, and inquiries were made respecting detectives in the southern colonies, and as a result the case was placed in the hands of a Sydney man. This was done without a single officer on Mount Morgan being made aware of it. The detective duly arrived, and was placed in possession of all the information in possession of the directors. The first difficulty was to get him employed in the mine. The officers there were quite in ignorance of his purpose, and if he went out to ask for employment in the usual way there was very little chance that he would get it. However, he managed to obtain a job with one of the contractors. Actually, he was not in the service of the company at all, though working on their property. He was set to bore slabs for tunneling work—a job that fell very heavily on one quite unaccustomed to manual work, and who had moreover to work tirelessly with brain and eye after his day's work was done. He made remarkably fine use of his opportunities, giving himself airs of a devil-may-care fellow, and pretended to be a finished scamp who particularly distinguished himself on the Cape gold and diamond fields, while he confidently told some he had stolen more gold and diamonds than any man who had ever set foot in South Africa. He thus gained the full confidence of the whole of the gang, and the men comprising it told him everything, and he was delighted to find himself among a lot of fellows so distinctly after his own heart. He joined with them hand and glove, he stole gold, assisted to disguise it, carried it to Rockhampton and sold it, and afterwards spent the proceeds in the most open-handed fashion. All the time he was planning the capture of the gang, and the information then obtained implicated a number of men, nine of whom were ultimately arrested.

The sampling of iron ores was the subject of discussion at a recent meeting of the Iron and Steel Institute when Mr. Thomas Clarkson, in a paper, described a machine devised by himself for cutting out a portion of the running stream of ore, in sampling, claiming that if the ore is of an average class and sufficiently fine, this system enabled a reduction of fifty or one hundred times —that is a 2 per cent. or 1 per cent. sample—to be effected safely at one operation. When the ore is very irregular in composition and of necessarily large size, a larger percentage, in some cases twenty, may be desirable at the first cut. The duplicates are then put together and reduced in fineness before cutting on a smaller machine. This appeared to be the first machine that had succeeded in cutting out a definitely required percentage of accuracy. The improvements claimed were (1) reducing the labor and expense, (2) eliminating the personal equation and dispensing with care in the operator, (3) shortening the time.

For producing additional economies in the construction of pumping engines, attention must be turned to the steam end of the apparatus, as pump resistances have already been reduced almost to a minimum. "The greatest field," according to Mr. F. W. Dean, from whose paper, read at a recent meeting of the New England Waterworks Association, we quote, "is in preventing cylinder condensation, and while the triple expansion engine has done much when intelligently designed, it would seem that the quadruple engine is justifiable where coal is not cheap, and this with pressures easily and safely carried. It would seem that the use of super-

heated steam offers the most promising field for the future in the prevention of condensation. In the past a durable superheater has not been produced, but at present I am of the opinion that it can be. The next difficulty is to furnish sufficiently high temperature waste gases for superheating from the boiler without injuring the boiler performance, so as to counterbalance the gain from superheating. Recent experiments that I have made with boilers of the locomotive type burning from 16 lb. to 70 lb. of coal per square foot of grate per hour show plainly that evaporation of over 13 lb. of water from and at 212° per lb. of conbustible can be obtained when gases are escaping at 600° Fahr. This is sufficient for considerable superheating, and such a boiler performance can be obtained with induced artificial draught. The remainder of the field for economy is chiefly to utilize all waste heat from the engine and boiler for heating feed-water."

The most economical steam plant of the future, he considered, will be designed as follows:—The boiler will be of the locomotive type, having a ratio of heating to grate surface of 75 or 80 to 1, working with over 200 lb. of steam, having artificial draught and burning 30 lb. or 40 lb. of coal per square foot of grate per hour. This type of boiler is selected because it is the most economical of all boilers, either when forced or not; will stand the highest pressures, extreme forcing and general abuse without harm for many years. It is the pioneer of high pressures throughout the world, and its success under the most trying conditions shows it to be perfectly safe. The engine used will be a moderately fast running vertical quadruple expansion, furnished with steam superheated by the waste gases of the boiler. The cylinders will be steam jacketed, and the initial steam in the high-pressure cylinder may be wire-drawn considerably below the boiler pressure. There will be reheaters between the cylinders, the condensation from the working steam side of which will be passed through evaporators in the smoke flue of the boiler.

In the last British consular report from Tientsin are described the works for the manufactnre of Portland cement, which are situated at Tongshan, 80 miles from Tientsin, and were erected three years ago. The plant is of the most modern description. The raw materials used are mountain limestone, fireclay, marl, and a rough kind of china clay, all of which are found in the immediate neighborhood of the works. The fuel used is hard furnace coke made on the premises, from the local bituminous coal. The limestone and clays have first of all to be reduced to an almost impalpable powder, which is then passed through the brush mill, whence it is pumped into the "backs," to be eventually moulded into bricks for burning into cement in the kilns. The greatest possible watchfulness has to be exercised at the "washing" part of the process, by reason of the limestones and clay being so variable in quality as they are delivered into the works, an analysis of the slip being necessary every half-hour or so. By paying close attention to this "slurry" of uniform analysis is obtained. Owing, however, to the different densities of the raw materials used, they settle down in the "backs" in their distinctive strata, and before the brick moulding can be done it is necessary to thoroughly turn over the "slurry" with the shovel and tread it well under foot in order to obtain a uniform mixture. The bricks are then transferred to the drying ovens, and in due time taken to the kilns for conversion into Portland cement clinker. Nothing but true clinker is ground at the Tongshan works. The resulting Portland cement is of great density—viz., 158 lbs. per bushel. The present output is 300 tons per week, and that is the limit of the capacity of the works. The cement is guaranteed to stand a tensile strain of 400 lbs. per square inch after having been immersed in water for seven days. In fact, it invariably tests much higher.

An exhaustive report of the British Vice-Consul at Palmero on the production of and trade in Sicilian sulphur has recently been issued by the Foreign office. Sulphur has, it appears, been extracted in Sicily to some extent for centuries, but it is only within the last 60 or 70 years that the industry has come into general and active operation. The quantity of ore extracted in 1891 was more than 2,500,000 tons; and the mineral obtained from this was 347,568 tons, of which 310,272 tons were exported. When compared with the production and exportation of 1830, which was 38,461 tons, it will be seen that the development attained was very great, but it must be remembered that Sicily is really the only sulphur producing country in the world, the few thousand tons exported by Japan not affecting Sicily in any way. The number of mines in 1891 was 818, of which 581 were working and 237 closed. The men finding work in and about the mines were 32,269, not including carters, drivers, carriers, storekeepers, &c., who are all directly or indirectly engaged in the trade. The total is roughly given at 50,000. Refining is carried on at Catania. There are seven refineries. The largest is capable of turning out 48 tons of refined sulphur in 24 hours, 2,000 tons of flour of sulphur during a season, and of milling 3,000 half-hundredweight bags of sulphur per day. The refining season commences in October and terminates in June.

The Vice-Consul concludes by describing the working of one of the most important and best managed of the mines, viz., Grottacalda, situated at about seven kiloms. from the town of Valguarnera, and 21 kiloms. from the nearest railway station at Assaro. It belongs to Prince Sant' Elia, and is at present leased to and worked by Messrs. J. Trewhella & Co. It produces about 15,000 tons of sulphur yearly, of which 22 per cent. is made over to the proprietor as rent. The extreme depth is 140 metres. There are three shafts, besides various "scale" or stairs leading into the mine. At the main shaft the ore is drawn to the surface by a 60-horse-power horizontal winding-engine, the cage containing a tram wagon with about 15 cwt. of ore at a time. The ore is extracted from the two smaller shafts by modern steam winches of 8 to 10 horse-power. There are three horizontal Lancashire boilers, each having thirty square metres of superficial heating surface, and two vertical boilers for driving the steam winches. The amount of water is about 1,000 cubic metres in 24 hours, and is extracted by a double-acting vertical beam pump (Cornish pattern) working in three lifts. The length of stroke is three metres, diameter of plunger 30 centims., speed of pump six strokes per minute; besides this there are three Worthington pumps in reserve in case of accidents. The quantity of ore brought to the surface in 24 hours is about 300 tons. The ore yields about 3½ cwt. of fused sulphur per ton. There are about 150 miners and 250 boys employed underground, divided into three shifts, besides an underground engineer and several foremen. The sulphur, when fused, is taken to the railway station by carts, 50 of which are regularly employed, and at times these are increased to 100; each cart takes about 14 cwt. of sulphur.

Commenting upon Sir Lowthian Bell's recent paper on "The Waste of Fuel involved in the Smelting of Ores of Iron," before the Iron and Steel Institute, the *Iron and Coal Trades Review* says:

"One of the questions which have from time to time formed the subject of discussion by ironmasters and engineers, is that of whether we are likely to witness any considerable increase of efficiency in the blast-furnaces in reference to fuel consumption. The reasoning and calculations submitted from time to time by blast-furnace experts appear to render it probable that if we have not absolutely reached finality of economy, with 18 cwt. of coke to the ton of pig, we are not very far from the attainment of that stage. It is, of course, possible that some other method of producing iron may ultimately displace existing methods, and that the newer method may involve economies that are not now dreamt of, but at the present time we have to face the conditions that actually exist, and not those that are theoretical and visionary; and taking things as we find them, it appears to be improbable that any considerable reduction on the best practice now current in making pig-iron, is likely to be effected. The great progress made in fuel economy during the last twenty years has been mainly due to four items, all of which have now been pretty fully discounted in practice. The first of these is the substitution of the hot blast for the cold blast, and on this point experts believe that practicable finality has been attained—in other words, that it is not commercially profitable to work blast-furnaces with a higher temperature than 1,500° to 1,600° Fahr. This consideration, therefore, limits the scope of any possible economy due to the increased temperature of blast. There is still, however, a difference of opinion as to what the future may produce in the way of changes due to the adoption of larger furnaces, constructed on different lines. It is well known that hardly any two works in existence build furnaces that are in all respects alike. Each blast-furnace engineer, and each ironmaster has his own theory and his own practice as to the form best adapted for the blast-furnace, and there is as much diversity of shapes, forms, and dimensions in blast-furnaces as there is in the construction of private dwellings. This, to a large extent, is no doubt necessarily the case, inasmuch as practice has proved that the form and dimensions suited to the smelting of iron under one set of conditions will not be found equally applicable to the same operation under conditions that are more or less different. The time, therefore, ap-

pears to be still distant when we may expect to see blast-furnaces erected after a uniform and stereotyped pattern, and that being so, the question of what further economies may be possible in the smelting of pig-iron must remain more or less an open one. The subject in all its bearings is one that is specially well adapted for the discussion of practical ironmasters, and although it does not present at the present moment any very exciting aspect, nor hold out any great hope of that relief which the trade is so anxiously seeking, there is no doubt whatever that it is a movement in the right direction."

The shipments of nickel matte and asbestos from Montreal, consigned to Europe, up to 18th ulto. were:

NICKEL MATTE.

Ganadian Copper Co.....	259	barrels....	Hamburg.
C. P. R	26	casks.....	Avonmouth.
"	26	"	"
"	22	"	"
"	43	packages..	"
"	44	" ..	"

ASBESTOS.

Grand Trunk Railway....	760	bags.....	Hamburg.
" "	560	"	"
O. M. Harris.....	889	"	"
Grand Trunk Railway....	20	"	London.
Irwin & Hopper.....	58	"	Hamburg.
O. M. Harris..... ...	915	"	London.
Grand Trunk Railway....	400	"	Hamburg.
" "	400	"	London.
" "	1200	"	Hamburg.
" "	400	"	"
Irwin & Hopper.....	300	"	"
Grand Trunk Railway....	400	"	"
" "	1024	"	"
American Asbestos Co....	400	"	"
Irwin & Hopper.....	3	barrels....	"
Johnson's Asbestos Co....	2	bags.....	"
G. T. R.....	600	"	London.
"	500	"	Hamburg.
O. M. Harris.....	38	tons.....	Antwerp.
"	100	bags.....	Rouen.
G. T. R.....	600	"	Hamburg.

A syndicate with a capital of £35,000 has been registered in England to purchase British or foreign patents, conferring rights in connection with the use of peat, or any product that can be obtained from peat and to carry on the business of bleachers, general dealers, manufacturers, exporters and importers, especially any articles which are the product of peat. The concern has been registered by W. L. Cooper, 5 Queen Victoria Street, London, E.C.

The next quarterly general meeting of the Mining Society of Nova Scotia will be held on Thursday, 7th December next in the rooms of the Society, Halifax. Three sessions will be held. Among the papers to be presented the following are announced: "The Asbestos Fields of Port-au-Port, Newfoundland," by Mr. C. E. Willis; "Early Iron Smelting in Pictou County," by Mr. H. S. Poole, M.A., F.G.S.; "Cast Iron Tubbing in Shafts at Sydney Mines," by R. H. Brown; "The Newbery-Vautin Chlorination Process, with results of experiments on some Nova Scotian Concentrates," by F. H. Mason, F.C.S. Other features will be the discussions on the papers read at last meeting, while the afternoon session will be wholly devoted to the discussion on the method of introducing new mining legislation in the local legislature as advised by the Premier on the 25th ulto. We trust every member of the Society who can do so will be present and participate in the proceedings.

Arrangements are being made by the General Mining Association of Quebec for an unusually interesting series of meetings in January. Among others who will contribute papers are: Dr. F. D. Adams and W. A. Carlyle, Ba. Sc., of McGill University; Mr J. Burley Smith, M.E., Glen Almond; Mr. F. Cirkel, M.E., Ottawa; Mr. Geo. E. Drummond, Montreal; Mr. J. Obalski, M.E., Quebec. The meetings will open on the second Wednesday of the New Year. The *Journal* of the Associatien, a somewhat bulky volume, containing the proceedings for the past three years is now in the press and will be ready, it is hoped, for distribution at the annual general meeting.

In the Annual Report of the Department of Crown Lands, Quebec, Mr. J. Obalski, M.E., Inspector of Mines, contributes much useful and valuable information respecting the mineral industry of that province during the year ended 30th June, 1893. The Mining Law, which was substituted by the Hon. E. J. Flynn in place of the obnoxious legislation enacted by the Mercier administration, has been found to work smoothly. During the year 132 prospecting permits were applied for and 102 granted, comprising an area of 19,743 acres in surveyed, and 130 square miles of unsurveyed territory. The revenue from this source amounted to $1,675. The sale of mining lands was much greater than the previous year, and the receipts exceeded those of 1892 by $3,594.75. An economy worthy of congratulation is the saving that has been effected by the reduction in the staff of the so-called mining inspectors of the Mercier régime, the expenditure of the Department having fallen from $16,296.71 in 1892 to $4,736.43 in 1893.

From the tabulated returns of the mineral production of the Province of Quebec during that period, given by Mr. Obalski, we glean the following:—

	Tons.		Tons.
Bog Iron Ore..	26,539½	Asbestos.....	7,248½
Magnetic " ..	1,550	Serpentine.....	300
Ochre.....	950	Phosphates.....	8,177
Copper(pyrites)	58,001	Mica (rough and	
"	50	dressed)	1,164
Lead.....	100	Feldspar.....	1,000
	Ounces.		Cub. feet.
Gold.....	355½	Granite.....	100,000
	Tons.		Tons.
Graphite.....	326	Slate.....	4,785

Taking 4,153 as the total hands employed in the industry it appears, says Mr. Obalski that the proportion of fatal accidents during the year was 1 in 1,034, and one injured for every 378 persons employed.

Every one we have met who visited the Canadian section at the Chicago Fair is disappointed at the very poor representation Nova Scotia made there. The exhibit as to coal was unworthy of an office display, and the two exhibits of gold, one of nuggets from Moose River, and the other of quartz from Caribou, were not representative at all of the quality and class of quartz from which the bulk of Nova Scotia gold is obtained. So long as Nova Scotians are content to have their mineral resources thus appear, so long will they lack the introduction of that new capital they so ardently desire.

Our last issue was completely sold out immediately after publication and we regret to have been unable to furnish many of our readers with the extra copies they required. A large portion of the surplus issue of the current number has also been purchased in advance of publication and readers desiring copies are requested to send in their orders early in order to avoid disappointment.

As customary the only official reports of the proceedings of the Mining Society of Nova Scotia, to be held on 7th proximo, will be published in the REVIEW. Our numerous asbestos readers will be particularly interested in the report on the new asbestos-bearing district now being opened up at Port au Port Bay, Newfoundland, to be presented in the paper by Mr. C. E. Willis, M.E.

A car-load containing 20,000 ore sacks has been shipped by the Canada Jute Company, Montreal, to their agent, Mr. R. E. Lemon, at Nelson. When it is considered that these will be placed in addition to the 18,500 already delivered to his customers, it is evident that notwithstanding the low price of silver the miners of Kootenay mean business.

For many years it has been known that the bars on many of our British Columbia rivers contain an immense quantity of flour-gold. Many and various have been the schemes devised to recover this gold, all more or less unsuccessful. During the past season the stimulus to the search for gold has resulted in an unusual number of these fine gold-saving machines. The *Mining and Scientific Press* refers to the latest appliance as follows: A prospector named Taylor, of Idaho, thinks he has solved the flour-gold problem, so vexatious to placer miners. He has invented an appliance, consisting chiefly of a sluice-box, in the bottom of which is a row of over-lapping boards. These boards, prior to being placed in the sluice, are smeared with white lead and then sprinkled with sand. Over this surface the water runs in a low stream. The gravel reaches the sluice through a grizzly. The gold and sand settle to the bottom and are caught on the sanded boards. After the sand and gold has accumulated it is taken up and amalgamated in a quicksilver bath. This device, it is said, can be worked at a cost of about $10 per day, and, while not perfect, it is credited with the best work yet done on the Snake River placers, where the amount of flour-gold is very large. It is said that Taylor's machine has been in use all summer, and cleaned up from $30 to $50 per day.

The Jeffrey Asbestos Mine.

Just as we go to press we learn that this well known property is on the eve of being transferred to a joint stock enterprise with a capital of $350,000. The mine is situated a short distance from Danville Station on the main line of the Grand Trunk Railway, midway between Montreal and Quebec, and has been worked continuously for many years, recently under the ownership of Mr. W. H. Jeffrey, of Richmond. The annual output has been in the neighborhood of 1,500 tons of all grades but this year we understand 2,000 tons will be produced. It has been carefully and systematically opened up, is equipped with ample accommodation for a good force of miners and a suitable working plant, while the product owing to its fine fibre has gained a high reputation among manufacturers of asbestos goods. We understand that the reason for this step is largely the great age of the owner who is now close upon eighty-six years of age. The property, which contains 75 acres, has proved a highly remunerative investment to the present owner and there is no reason why it should not continue to be so if operated by a syndicate properly administered on a reasonable capitalisation.

The Montagu and Waverley Gold Districts.

The districts of Montagu and Waverley present many points of interest to both the stranger and the mining man.

On the eastern side of Halifax Harbor lies the town of Dartmouth, from which a drive of seven miles, five of which lie along the wooded shores of a lovely chain of lakes, brings the traveller to the mining district of Montagu. The first discoveries here were made in the summer of 1863, in which year 140 tons of stuff were milled yielding 336 ozs. 14 dwts, an average of 2 oz. 16 dwts. per ton, which average has been pretty well kept up, the general average from the beginning in 1863, to the end of 1892, being 1 oz. 18½ dwts or about $38.00 per ton. This is the highest average value per ton of any of the gold districts of the Province*, but is also an index of the character of the district when taken in connection with the total number of tons milled, viz. 18,771 in 30 years.

The inference from these figures, that the district hitherto has been one of rich streaks or pockets, is borne out by examination of the workings, but from the character of the work carried on during the past year by Mr. Thomas and others there is ground for believing that the lower grades of quartz will be found workable at a profit.

As we enter the district by the branch road from the main highway, one sees to the right and extending westerly the old mine buildings and rock dumps of the once famous "Lawson" property, now owned by "The Nova Scotia Gold Mines, Ltd.," an English corporation controlling the major part of the district. The "Lawson" lode was worked to a depth of about 360 feet many years ago, and has since been idle. West of this property, and at the western end of the district so far as yet worked, is the "Symon-Kaye Syndicate, Ltd.," also an English corporation, now under the management of Mr. Alfred Woodhouse, resident director. Some years ago the property produced quite largely. Since the transfer to the Syndicate in 1892 attention has been chiefly directed towards the prospecting and developing of the property. A ten-stamp mill has been built and pumping and hoisting works erected. From the specimens on view in the office it would seem probable that pay ore is close at hand, when the equipment which is yet rudimentary, will be increased.

Returning easterly through the Lawson ground the next property traversed is the "Annand," once known in London as "The New Albion." These claims for the last ten years have been the chief producers in the camp. Sold in London about the beginning of 1884, the mine has

W. R. Thomas, F.G.S., Nova Scotia Gold Mines, Ltd., Montagu, N. S.

had alternate periods of large and small production, and has endured all sorts and kinds of management in that period. In October, 1892, Mr. W. R. Thomas came out from England and took charge of the poperty. By him many changes and reforms have been inaugurated, work systematized and economies practised. It is no flattery to that gentleman to say that he has accomplished with credit the herculean task he had before him. Many contemplated improvements remain to be completed. The property has a ten-stamp mill with combined pumping and winding gear, also an independent winding engine. New buildings and boiler equipment are in process of construction, and we were glad to note an assay office that was apparently in daily use. Developments are confined to two veins, the "Twin Lode" and the "De Wolfe." The former is worked by crosscuts 80 feet in length from the De Wolfe lode. The latter has one shaft well on to 300 feet deep, with levels therefrom. This De Wolfe lode is known far beyond the boundaries of Nova Scotia for the magnificent nuggets and specimens obtained from time to time. Where these rich pockets are found the lode is large, often 15 to 16 inches, in other places it is smaller, sometimes running to 5 or 6 inches.

Just south of these works and extending westerly over 1000 feet lies the property of the Salisbury Gold Mining Co.—an excellent "prospect," badly equipped with mill and machinery, Several very promising lodes on this property await development.

To reach Waverley from Montagu one retraverses the two miles of branch road to the main post road, and thence drives five miles along the picturesque shores of the lakes, whose variegated foilage at this season completes a picture of surpassing beauty.

It is not going too far to say that Waverley is one of the most picturesque and charming mining villages to be found in this or any other country. For variety of mountain, forest and lake scenery it is famous. Two large lakes end to end, the one flowing into the other, divide the district into East and West Waverley. With the steep precipitous hills on the one side, gently rolling slopes on the other, and comely houses nestling among the trees along the shores of the lakes and borders of the road a picture is photographed on the retina which will be long remembered for its beauty, and which does not suggest the digging and delving, the smoke and dirt invariably associated in one's mind with mining villages and operations.

In the total amount of gold produced Waverley stands the second district in the Province, its total yield to January 1st, 1893, being in excess of one million of dollars. Discovered in September, 1861, from its accessibility and proximity to Halifax a large number of people were quickly on the ground, and many claims applied for, the Government returns showing 46,800 days labor performed in 1862.

For the years 1864-65-66, there was a total production of nearly $600,000, but following the exhaustion of the surface streaks came a partial depression, followed in 1871 by a revival which lasted until 1877. From 1878 until the fall of 1889 Waverley lay quiet, in the hands of prospectors and tributers only, and for these twelve years the average annual product was only 180 ounces.

The good genius of the place has been and is still Mr. B. C. Wilson, who has been a continuous resident of Waverley since 1862. Through his efforts, in 1889 a strong American company, with a share capital of $500,000, acquired a large property in West Waverley, known as the "American Hill" claims. The services of a man well known in Nova Scotia were secured, and the company proposed to erect a model plant and treat the low grade ores of Waverley on a large scale.

This announcement was pleasing to everybody, as the district had an unimpeachable record and the success of this enterprise meant the introduction of capital to the gold mines of the province.

Work was prosecuted for nearly three year[illegible] large underground developments were made; [illegible]

* The highest individual yields per ton are from Oldham district where recently several tons yielding 100 ozs. per ton were crushed, and in 1891 eight tons yielded at the rate of over 80 ozs. per ton.

extensive and expensive surface plant was erected, embracing a powerful hoist capable of handling 1,000 tons a day, a large air drill plant with accessories, a thirty-stamp mill with magnificent Corliss engine, Frue vanners, &c., and a laboratory for assay and analytical work. In all a sum total of $150,000 was expended, but in April, 1892, the big bass whistle ceased to blow, and work stopped. The immensity of the equipment precluded all hope of dividends from the commencement.

Meantime others have been stimulated and in 1891 there were five companies operating. The English company ceased work when its property was transferred to another syndicate, and now there are but two working mines in the district.

The first of these, in East Waverley, is managed by Mr. Wilson, who has driven a cross-cut tunnel into Laidlaw's Hill a distance of 635 feet, cutting at that point the Barrel quartz lode, at a distance of something like 200 feet on the incline below the outcrop. The vein has been opened systematically by levels and upraise and everywhere shows a large body of quartz, the vein running from 10 inches to 20 inches in thickness. Only one small lot has been milled, yielding about 8 dwt. per ton, but the mine is now ready for its milling equipment and will undoubtedly give a good account of itself.

The "Newest Child" is the West Waverley Gold Co., Ltd., which began work in February, 1891, milling in April 1892, and has been working continuously since. From its inception the West Waverley Company has been under the management of Mr. John E. Hardman, also manager of the mines at Oldham. We publish in this issue an illustration showing an exterior view of the new mill, which has been pronounced by those competent to judge the most economical and best adapted plant for its capacity ever erected upon a mine in Nova Scotia. The plant comprises a 20 stamp mill of most modern pattern, with a duty of 60 tons per 24 hours, equipped with rock breaker, automatic feeders and concentrators, operated by a small tandem compound condensing engine. The air compressor is a Rand duplex compound condensing machine, of 10 drill capacity. The steam is generated in one nest of boilers for the whole plant and is successfully carried 500 feet up the hill to the hoisting engine which is of the double drum, friction, double cylindered type. The mine water is handled by a single action pump operated by compressed air, and the water supply for the works is pumped from the lake also by compressed air. All stoping is done by single hand work, and hoisting is done on day shift only. The company is now handling 1000 tons of quartz per month from veins averaging from 10 to 16 inches in width, and worth about 5 dwts. per ton. We are not in a position to state what dividends are being paid as the company is a close corporation. The mine adjoins the Lake View Company on the west and has a length on the veins of 900 feet.

General View of the District of Waverley. N. S., showing Mining Buildings in distance.

CORRESPONDENCE.

Gold Mining at the Lake of the Woods.

To the Editor of the Review:

SIR,—The mining industry of the Lake of the Woods district is decidedly settling down upon a firm and sure foundation. Businesslike and legitimate development is now going on upon, at least, four distinct locations, in the light of which operations the ancient bugaboo which has for so long a period been dangled before the timid eyes of our infant enterprise is rapidly being relegated to the limbo of exploded fads and superstitions. I refer to the opinion so frequently heard in the past, that the ore deposits of this wonderfully rich country possess neither depth nor permanence. This altogether groundless assumption has been so frequently and generously exploited in our behalf that a great many mining men have been induced to accept the statement as being perfectly true and in accordance with the results of careful and practical experiment; and this much to the disadvantage and injury of our good name and reputation. No doubt this fallacious idea had its birth in the half-expressed opinions of certain scientists upon the geological formation of the country, for in no single instance, where properties were opened out and partially developed in the early days, did it ever occur that the operations ceased because of the pinching out or poverty of the ores. I might mention in this connection the Ophir, the Winnipeg Consolidated, the Pine Portage and a number of other locations upon which work was commenced some decade ago and afterwards abandoned because of financial difficulties and partnership squabbles; but which are well known locally to be rich beyond calculation in beautiful free milling ore. The locations, however, which we have at present to deal with are those now in actual operation, the acquirement and working of which by the companies interested marks the new stage and era in the development of Western Algoma.

Of the Sultana your readers have no doubt heard, as frequent notice of proceedings in that quarter appear in the local and Winnipeg press. The mine is owned and worked by Mr. J. F. Caldwell of Winnipeg. A ten stamp mill is operated on the property which is being run ten hours daily. Bullion is being produced at present at the rate of about one thousand dollars per week, with an unlimited amount of ore in sight. The mill and mine are open for inspection, and any intelligent visitor would I am sure be courteously received and given any information he might desire by the gentlemen in charge of the works. Mr. Justice Street, who has been here during the past week holding Assize, paid the Sultana a visit in company with a number of legal gentlemen all of whom were very much impressed with what they saw. If, therefore, any of your readers doubt the accuracy of any of your correspondent's statements let them follow the example of Mr. Justice Street and come and see for themselves.

I should require several columns of your valuable space to clear the ground for a proper understanding of the situation here; the tale shall, therefore, for the present remain untold. Among other companies interested is what is now known as the Rat Portage Reduction and Mining Company, a rich and powerful concern representative of American capital. These people have secured a number of locations, some of which will undoubtedly turn out good. Among others they own what is called the Bull Dog or Black Jack mine and though their first intentions were to enter into operations on a very extensive scale, the money troubles over the line have induced them to confine themselves, up to the present, to the development of this one property. The work here will be watched with no small degree of anticipation by those who have an interest in the country, as it is the intention of the company to demonstrate beyond cavil the thorough reliability of our ore deposits in the matters of both quality and depth. This work will be prosecuted not from any philanthropical motives, but because the company have invested largely in the district and it suits their purpose best that the local mining industry shall be placed in a flourishing condition as speedily as possible. One reason for this is that they will have a large and fully equipped customs mill ready for work early next summer and as of course they desire to make this a profitable and paying institution, and as all locations now operating possess their own mills and plant, they wish to induce others to come in who might decide upon favoring the customs mill with the treatment of their ores. Nothing, they think, will further their very reasonable desires in this connection more than the success of the test which is now going on upon

their Black Jack property. Steady sinking will therefore go on there until a depth of at least two hundred feet is reached when drifting will be commenced so as to cross-cut two other veins on the location, upon which work will be carried on simultaneously. Air drills will supplant hand drills in the work of mining. These arrived the other day from Sherbrooke and are now being placed in position under the able superintendence of Messrs. Payne and Brent. The shaft at present is between eighty and ninety feet deep.

On the Gold Hill location a new mill is just commencing to run under the supervision of a mining engineer from Colorado. The mining operations here are under the management of Captain William, late of the Beaver mine, a practical miner well-known throughout the entire district of Algoma. Mr. Dan Burdette is the local head and front of this syndicate, the capital interested being American from the neighborhood of St. Paul and Minneapolis. Bullion is expected in from this mine in the course of a few days.

The Bad mine has been purchased by Mr. Semple of Hoskosh, and a contract let for the sinking of a fifty feet shaft. This mine is located in the vicinity of Rossland and the indications are most excellent.

A number of other locations are being opened by prospectors and next summer will surely see the district making rapid strides along the lines of progress.

In conclusion we have been visited during the past summer by many eminent experts all of whom expressed their great satisfaction with the indications held out. A great English authority, Mr. Pasco, of London, Eng., who was out for old country capitalists was much pleased with what he saw and returns in the spring for further and more extensive examination. Much has been said and written for and against the country. Many absurd and wilful exaggerations have been spread abroad in regard to it, but we who have resided in the locality for a considerable period and without being interested to the extent of a single cent directly or indirectly in any of the mining properties, cannot resist the impression that Algoma district is bound in the very near future to assert itself as one of the richest mining centres of the continent.

Rat Portage, 29th Nov. 1893. H. H.

Dr. Hoepfner's Electrolytic Process for Extracting Copper, Silver, Gold, etc., direct from Ores.

To the Editor of the Review:

SIR,—It may be interesting for a number of readers of the MINING REVIEW, whose time does not permit them to study the current and voluminous productions of the literature of electro-metallurgy, to hear something about a process, which although not quite new, deserves a wide publicity on account of its important innovation on existing methods in reducing copper and silver ores.

If we look at our bookshelves and see the great number of stately folios on metallurgy, and let pass in our minds the many hours of hard study and practical trials of tedious smelting and subtle-leaching processes, and think what a relief came over us, when electricity commenced "to take a hand" in it, and when men like Elkington, Marchese, or Siemans and Halske, substituted the electrolytic deposition of copper from matte—what a simplicity compared with that wonderful complicated work of repeated roasting, smelting and leaching of ores and mattes. After a number of years of trials, failures and improvements, this primogenial work of electricity did not quite fulfil to satisfaction what the *pater familias* expected. In the first place, the casting of the matte to such thin plates, as were necessary for the anodes, was attended with a number of difficulties; second, these anodes after hanging for some time in the baths, became unevenly dissolved, and at last so soft that they often fell from the connection and the process was interrupted; third, the electrolyte became after a short time so saturated with all kinds of impurities which existed in so concentrated an amount in the matte, that if great care were not taken, either the deposition of the copper was partially interrupted or other metals were deposited with the copper and consequently the latter lost in quality. Matte anodes need a tension up to 1.5 volts, and besides a large portion of the current is wasted by doing extra work, dissolving other metals in the matte which are not wanted. Therefore electro-metallurgists tried for a number of years to establish a method by which the above mentioned defects would be avoided and a saving in cost of treatment produced, but at the same time a product obtained which could be pronounced chemically pure.

It was however not until 1886, when Siemans & Halske took out a patent on an electro-chemical process "for the production of metallic copper directly from its ores by electrolysis." It was a great improvement upon the foregoing, yes I might say something quite different and much superior to the other. I will give here a short description of this process, which is based on the solubility of monosulphide of copper (Cu S), of subsulphide (Cu_2 S), of oxyd (Cu O), and metallic copper in a solution of ferric sulphate [Fe_2 $(SO_4)_3$], and consists of two parts: first, a chemical, and second, an electrolytic.

First part: the matte, or the ore whose copper contents must be in a chemical combination as above stated, is ground to a fineness of 90 meshes, preferable in a Krupp ball mill, and transferred into leaching vats. In case the copper is in a different chemical composition in the ore as just mentioned, for instance, chalcopyrite (copperpyrite), which is a double sulphide, it is first partially roasted and the copper formed into a subsulphide, while the iron into an oxyd and rendered insoluble. The leaching solution is now brought in contact with the ore and under continuous stirring and heating to about 90° Celsius so long left in contact with it until all the copper is leached out, which will take about 10 hours. The tailings are then sent to a filter press and any remaining solution pressed out, after which the residue will show by analysis not more than 0.1 or at the most 0.5% copper. The liquor is then run into the settling vats from which the clear solution flows into the the electric vats.

This brings us to part second. The lixivium before entering the leaching vats consisted of ferric sulphate [Fe_2 $(SO_4)_3$], as above stated, but after finishing leaching it has changed and leaves the vats as a ferrous sulphate (Fe SO_4), because it gave two molecules of acid to the copper, which is dissolved out of the ore. This action may be understood by the following equation:

$$Cu_2 S + 2 Fe_2 (SO_4)_3 = 2 Cu SO_4 + 4 Fe SO_4 + S,$$

and in this composition it flows with the cupric sulphate through the electric baths. The latter loses its copper in depositing it on the cattodes which consist of sheet copper, then the liquor flows down from the cattodes to the anodes, the ferrous sulphate is oxydized and combines here again with the two molecules of sulphuric acid, set free through the decomposition of the cupric sulphate and is restored to its original form into ferric sulphate. Owing to its greater specific gravity it settles on the bottom of the bath, is drawn off from here and is then ready to perform its work as a lixivium over again.

We see by what I have just said that the whole process forms a cycle, and if we consider it from a practical and

Mr. John E. Hardman, S.B., Managing Director, West Waverley Gold Co. Ltd.

economical standpoint, its advantage over all earlier methods of reducing copper are so important that it is only a question of time that we shall substitute for all pyro-technical, these electro-chemical processes.

However, this process has one disadvantage, *i.e.*, in applying it to ores containing precious metals. Heater ferric sulphate with free sulphuric acid will not dissolve metallic silver or gold and only to a small extent, if they are present as sulphides or chemically combined in the ore, but are at once precipitated by the action of ferrous sulphate and will then remain in the slimes; nor does it devclop, as an electrolyte a very high electromotive power even not with the presence of free sulphuric acid. The deposition of copper at the cattodes is only about 1.18 grammes per ampere-hour; while for instance a solution of cuprous chloride and an nalogan salt are able to deposit double the amount, consequently the process is not so economical as where an electrolyte of the latter composition is used and consequently also the installation of the electric plant has to be of double the size.

This brings us to a process patented by Dr. Hoepfner "for treating ores containing copper, silver, gold, lead, nickel, cobalt, etc., by electrolysis."

The principal of this process is about the same as the above described Siemens & Halske, with the exception that the lixivium is applicable to all copper ores roasted or not roasted, and that the electric baths and lixiviation vats are a little differently arranged and that there are besides some precipitating vats.

The dissolvent used is here a cupric chloride saturated with chloride of calcium, which is brought together with the ore in revolving leaching drums and heated by steam from the exhaust pipe of the engine to a certain degree. It depends on the nature of the ore how long the liquor has to stay in contact with the former, two to six hours sometimes more. The lixiviation is done in two stages, the new liquor, as it comes from the electric baths, is first used on ore, which has been leached before and then brought in contact with fresh ore, to secure a complete extraction of all the the economic metals. Seldom will the tailings show more then 0.05 per cent. copper, almost no silver and no lead. If the ore contains also gold and it should be extracted simultaneously with the other metals, the dissolvent has to be saturated with chlorine by electrolysis, or the tailings are roasted and charged electrolytically with chlorine and the gold leached out in the usual way. Should there be water power in the neighborhood to produce cheap power for the dynamos, the manufacture of chlorine, by the patented process of Dr. Hoepfner would be so cheap, that the extra cost for roasting would be not very much increased especially as the volume of the tailings is considerably reduced through the leaching out of the different metals formerly in the ore. But following again the circulation of the liquor now charged with the various metals, it is conveyed or drawn off from the leaching drums into settling vats, where on cooling all the lead falls out, iron, arsenic, antimony, nickel, bismuth, etc., should such metals be present, are precipitated, and if the silver is not to be freed from the solution by electro-deposition, it is run over copper plates and precipitated in the well known form. The liquor which contains now only the copper, eventually also gold and platinum yet, flows in two separate streams through the baths, one passes the anodes and the other the cattodes, which consists of copper sheets. On the latter it is where the copper in the solution is precipitated, adhering to it so solid that it can be brought in this shape to the market, and if the process is conducted rightly and carefully, there should be only traces of impurities in the precipitated copper, how, analysis, made by Prof. Dr. Fresnuis, the well known chemist, readily will show, although the ore used was of a very impure character:

Sulphur, O.0004 per cent.; Iron, trace; Arsenic, little trace; Antimony, little trace; Lead, very little trace; Nickel and Cobalt, O.0012 per cent.; Molybdenium, O.0025 per cent.; Copper, 99.9961 per cent.

After the copper is precipitated out of this part of the solution which flows along the cattodes, it unites with the solution which comes from the anodes and is restored again into the same chemical composition as it was before entering the leaching vats, and therefore ready to perform its work over again. To make this more clear, we have to consider that the solution before entering the leaching drums, consisted of cupric chloride (Cu. Cl_2) and after leaching it was changed into cuprous chloride (Cu_2 Cl_2). ($= Cu Cl_2 + Cu = Cu_2 Cl_2$). This solution enters the electric baths in two separate streams, one at the cattodes and the other at the anodes. The first one loses its copper in its passage through the baths and setls chlorine free, while the latter retains its copper, but is changed at the anodes from cuprous chloride into cupric chloride taking up the two atoms of free chlorine

$$= Cu_2 Cl_2 + 2 Cl = 2 Cu Cl_2.$$

and mixes in this combination after leaving the bath, with the solution coming from the cattodes and the liquor is therefore restored to its original form; in other words the cupric chloride solution which had 60 grammes of copper in the litre, when it was brought into the leaching drums, had 120 Grammes, when it left them and had 60 grammes again after leaving the baths. Through this it will be easily understood that the whole process constitutes a cycle, and when I said above that the Liemens and Halske process had been a great improvement on all earlier copper reducing methods, so is Dr. Hoepfner's process of still greater importance, not only that the latter has the advantage of being more economical, but also enables us to extract silver and other metals from the ores, so to say free of cost and as a mere by product.

There are already quite a number of works in operation in Europe and also some in the course of erection, which not only proved the great superiority over old smelting processes, but verified also the figures which Dr. Hoepfner gives us in regard to the production of the copper. Dr. Hoepfner tells me that in producing two metric tons 4,408 lbs of copper in 24 hours from an ore containing 10 per cent. of copper, silver, etc., the ton would cost $36.63 or 1.56c. per pound, the silver would be free of cost. Of course these figures are taken from European works, and based on a yearly working expense of $26,380; but if we adapt his figures to our conditions, we would arrive at a sum of nearly $40,000; this would increase the cost of production to 2.8c. per pound. Also these figures do not include the cost of mining, by which the price of the copper would increase to perhaps 3.7c., and if the ore should first be concentrated, before giving it to the grinding and leaching department, the cost would further rise, but would be balanced again through the reduction of the grinding, leaching, precipitating, and in case gold is present, also in the gold extracting plant.

If we consider the present low market price of copper and the high production price of Lake Arizona copper, we have here a process, which will enable us in this part of North America, with our immense deposits of auriferous and argentiferous copper sulphurets, and with our almost ubiquitous great water powers, to compete with any part of the world. What a saving would it be alone for the mine owners in British Columbia, with their highly argentiferous and partly also auriferous copper ores, compared with their present conditions in being obliged to send the ore to Tacoma, or any other United States smelter, and paying as high as $100—expenses for reducing and shipping one ton of ore—and that which they ship is principally hand picked ore, the milling ore, perhaps the bulk, goes to the dump and there is another loss on interest in money invested. Perhaps most of these milling ores could be treated directly by Hoepfner's process, or if a concentration should be of more advantage, it should be treated by the right milling machinery, with which it could be classified and separated into its different

constituents. What kind of machines for this purpose would be the best, I shall speak of in another article, if the MINING REVIEW kindly will allow me space for it.

F. HILLE, M.E. & Ch.

Port Arthur, November, 1893.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Nova Scotia.

Caribou.

Little news comes from this district, Messrs Dixon and Co. continue working with usual results, and Mr. Sandey, who is operating the old Lake Lode property under a lease or a bond, is also keeping his force at work. Rumor says, he recently brought 67 ozs. to Halifax, as the result of his first clean up.

Owing to internal troubles the property of the Truro Gold Co. still lies idle, a fact which every one cognizant of the property deeply deplores.

Darrs Hill.

Such returns from this mine as appear in the Mines Office, show a continuous falling off in the quantity of quartz raised and milled. As the vein at present runs from 6 to 10 feet wide, the tonnage seems inexplicable unless it is "estimated," in which case the average per ton is of no value.

Killag.

Mr. H. S. McKay, one of the owners of the old Provincial Co., paid this property a visit in the early part of the month. The shaft is still sinking, but no stoping is doing. Expectations as to the production of this mine, from the reserves opened up, have not been realized for the reason that the policy has been not to remove the reserves.

Sherbrooke.

There is nothing to record from this camp. The big deal mentioned by the Halifax Critic with characteristic mendacity is denied by the parties interested.

Stormont.

The Richardson mine promises to be the "Banner" mine of the Province for this year. The lode fully maintains its average yield, and runs from 6 to 13 feet in width. The twenty stamp mill is kept fully occupied and has a capacity of between 500 and 600 tons per month. The yield for October was 263 ounces.

Reports from the Antigonish mine at Country Harbor are favourable. The quartz maintains its average, and the new machinery works smoothly and gives great satisfaction. The changes in the plant were made by the Truro Foundry Co.

Oldham.

The Rhode Island Co. have decided to sink their shaft (now 200 feet deep) an additional 150 feet. Quartz taken from the stopes to the westward were poor and small. A portable boiler with engine attached is to be shipped from Rhode Island for use at the mine.

The Concord Co. has had a streak of luck. Crushings from the Galena lode, 2 feet thick, yielded 6 dwts. per ton. The lode is persistent in size and promises well.

Molega Barrens.

A rumor, which lacks confirmation says that Mr. Ballou of the Boston Gold Mining Co. recently milled 78 tons from a new lode which returned 111 ounces or about 1½ ounces per ton. This new discovery is said to be 5 feet wide. If this is true, the district will receive a much needed impetus, and its production may be enlarged.

North Brookfield.

The patented process (a modification of the cyanide process) which has been on trial here with Mr. John McGuire, has not given satisfactory results. The extraction has not been so large as was expected, and the recovery of the gold has been more difficult.

Montagu.

The results for October work at the Nova Scotia Gold Mines Ltd. have been very satisfactory. The clean up reported was 80 ozs.

Mr. Woodhouse reports that the Symon Kaye group is looking well, and that a recent crushing was more than satisfactory.

Quebec.

The Canada Paint Co. and the St. Maurice Metallic Paint Co. employ close upon 50 men in the production of ochre. The works of the latter are at St. Malo, in Champlain County, and the company reports itself as being satisfied with the quantity and quality of the mineral being obtained.

Reports from the Gold district of the Chaudière indicate the prospect of an increased activity in the near future.

Mr. Fernando Wadsworth who has been conducting exploratory work for the American Gold Company, on Lot 11 of St. Charles, and 14 and 18 of DeLery, reports satisfactorily on the occurrence of gold on the property, and that his company will extend their operations next season.

Mr. E. B. Haycock has his small mill running on ore, but returns are not available. Quartz ledges of considerable promise have been uncovered during the year. Mr. Haycock is also prosecuting alluvial operations in the bed of the Du Loup.

Mr. W. H. Walker, of the Walker Mining Company, operating in the Township of Buckingham, writes that the new machinery for the mill is now on the way, and that he expects to be mining and milling in January. The property will be taken over by a joint stock enterprise in the spring. The exhibit made by this company was one of the most complete in the Canadian Court at the World's Fair.

The outlook for asbestos shows signs of improvement. While there has been with one or two exceptions, no notable activity in production, a large quantity of the stock on hand has been sold and shipped. Most of the mines have now shut down for the winter, the Bell's and American companys being notable exceptions.

It is reported that some rich deposits of mica have been uncovered recently at the Lake Girard mine.

During the season satisfactory development work was carried on at the Beaver Lake mica mines in Little Bergeronnes, owned by Messrs. P. P. Hall and others of Quebec. The mica bearing vein carries a width of 50 to 140 feet, and has been traced for fully a mile, showing numerous crystals of good size and merchantable quality.

The mica produced from the McGie mine at Escoumains, in the Saguenay region, is being dressed in the factory of the owners at Quebec.

In the Gaspé district the Petroleum Oil Trusts continue the borings in and around Gaspé Basin. Up to the present time eight wells have been sunk, and another is driven. A light green oil, of fine quality, analogous to that of Pennsylvania, has been struck in several of these wells, in small quantity, it is true, but sufficient in volume to encourage further researches and efforts. There can be no doubt that petroleum exists in this district, but of course the difficulties attendant upon operating in this line in an unknown district, comparatively, confront the management; however let us hope that the company having displayed such enterprise will eventually succeed in striking the oil in paying quantity.

Messrs. Clemow & Powell have about 25 men mining mica on their mine in the Township of Hincks. The product is reported to be of large size and in quantity. About 150 tons have been mined, a third of which will cut 4 x 6 and upwards.

The extension of S. W. drift, 30 ft. level, at the Crystal pit of the British Phosphate Company, Glen Almond, has uncovered one of the three fine deposits of phosphate pierced by the diamond drill, corroborating fully the accuracy of the test holes recently made by the company. The value of the drill in mining Canadian phosphates and similar irregular mineral deposits will form the subject of an interesting paper to be given by Mr. J. Burley Smith, the manager, at the next meeting of the General Mining Association of this Province.

Ontario.

The mill at the Ophir mine is running on quartz and reports from the mine speak very highly of the results, the returns being abont $5,000 per week. Supt. Wallace has gone for a well merited vocation at date of writing.

Two shifts are working at the Creighton Gold Mining Company's property in the Sudbury district. The main shaft is down 160 feet and is still sinking, but no milling has been done yet.

British Columbia.

Slocan District.

Winter set in regularly towards the end of October at the mines, driving in the prospectors and closing those mines which were not protected from the severe weather; but at about 25 of the mines men are at work, intending to continue throughout the winter.

The road has been practically impassable for the ore waggons during the last three weeks; a few tons have come down on mule back, but most of the mines are holding back, waiting for the sleighing.

A few sleighs went out this morning (Nov. 16th), but there is not sufficient snow to make a good road as yet.

The Washington has 40 men at work, and 300 tons of ore ready waiting for the sleighing. The Slocan Star has 14 men engaged chiefly in erecting ore sheds, etc., and they are winning some ore. At the Noble Five 16 men are employed, and at the Dardanelles, Northern Belle, Blue Bird, Freddie Lee and several others, from 10 to 20 men are being kept at work, and from 5 to 10 will be working in the other mines during the winter.

A fair estimate places the number of miners at work at about 250, and it is estimated that as soon as sleighing commences more than $100,000 worth of ore will be shipped monthly from Kaslo.

The following table is an accurate list of the ore shipments that have been made from Kaslo since the first of August:

Date Shipped.	Name of Mine.	No. of Sacks.	Gross Weight. lbs.	Valued at
Aug. 4	No. 1	....	74,000	$3,700
7	Wellington	....	36,720	3,672
14	Bon Ton	86	9,000	1,000
30	Wellington	297	31,165	2,800
Sept. 6	Blue Bird	591	80,000	4,709
8	No. 1	921	66,000	3,300
12	Dardanelles	265	25,262	6,373
12	Idaho	223	40,947	3,200
16	Mountain Chief...	225	41,091	2,950
18	" " ...	1006	109,061	7,780
20	Freddie Lee	731	98,000	7,644
23	Wellington	289	32,245	3,055
25	Dardanelles	319	32,787	6,273
25	Noble Five	1933	211,126	14,313
25	Blue Bird	454	60,173	4,143
28	Washington	570	80,000	5,524
30	Idaho	310	39,679	3,041
Oct. 5	"	304	39,500	3,385
9	Miner Boy.....	128	7,448	551
9	Idaho	554	63,400	4,906
9	Sampler.....	16	1,570	200
9	Northern Belle ...	3	330	30
10	Mountain Chief ..	280	40,000	2,871
14	Dardanelles	264	25,647	2,634
21	Idaho	369	40,000	3,030
21	Mountain Chief ..	395	40,000	2,735
23	No. 1	392	26,000	474
28	Idaho	310	36,000	2,754
30	Washington... ..	754	110,000	7,128
Nov. 1	Dardanelles.... .	404½	40,000	4,744
1	Alamo	299	33,700	2,409
			1,570,852	$121,238

The above list is taken from the records of the customs collector at this port. The value annexed is undoubtedly at the very lowest figure, as the duty charges are estimated according to the value of the ore.

The surveys for the Kaslo-Slocan Railway from Kaslo up the south fork of Carpenter Creek are completed and the contracts for clearing the right of way calling for the completion of the work by January 1st have been let and the men are hard at work.

The re-commencement of work on this railway it was thought would again boom Kaslo into something of the excitement which reigned here last winter. But Kaslo seems proof against excitement for some time to come. It is working away steadily paying little attention to the price of silver or to railway schemes or to anything in fact except its output of ore.

Kaslo is now a city—the seventh city in British Columbia—and is now settling down quietly to the management of its own affairs, and though for less than two years the habitation of man, she holds herself high, conscious of a history and a name.

The C.P.R. has been making strenuous efforts to reach the mines from the other side—from the north-west. The surveys for a line from Nakusp, on Upper Arrow Lake, to the head of Slocan Lake and then on to New Denver and up to Three Forks have been completed and the clearing of the right-of-way and the grading are nearly finished, while some ten miles or more of rails have been laid from the Nakusp end.

A short line from Revelstoke down the Columbia some 10 miles, now nearly finished brings the railway to deep water thus establishing connection via Nakusp throughout the winter.

Next summer will see two lines of railway to the heart of the mining district.

The big boulder of galena is to be broken up this month and thus one of the most unique of mining curiosities will be destroyed.

It is expected that it will realize in the neighborhood of $20,000.

(From The *Miner.*)

Most of those holding claims in the Toad Mountain district, assert that now that the Hall Mines Company have taken hold of their work in earnest, it will be far less difficult to secure development capital for other properties near the big mine. Some forty or fifty men are busy in and around the Silver King. The trial shipment is nearly ready, and will go out in a few days. The tram line, which will be four and a half miles in length, according to the present surveys, has been located and the preliminary surveys sent off. The construction work on the tram line will begin at the earliest possibly period in the spring.

Mining men who have lately come in from the Slocan, say that it is difficult to estimate just what the winter output will be, as many of the mines are simply piling the ore up on the dumps. This is done to await the cheaper winter transportation. With the completion of railroads, not only will all of this be shipped out, but a considerable quantity of second grade ore that will not stand the present rates will be shipped. With competing lines of railroads to force the output to its highest capacity, the mines of the Slocan should send out several hundred tons of ore daily.

A force of men are at work on the Slocan Star, and the company figures on taking out 400 or 500 tons of ore this winter. According to present arrangements this ore will be stored at New Denver until the completion of the railroad.

(From the Kaslo-Slocan *Examiner.*)

The total export of ore from Kaslo since the first of August aggregates 840 tons, valued at over $135,000. The major portion of this was shipped to the smelters at Tacoma and San Francisco.

J. M. Harris is down from the Rico mine, and is positive that with a force of fifteen men he can take out $150,000 worth of ore, with silver at 70 cents per ounce, in the next five months. At present the Rico shows up in splended shape. There is a continuous ledge for over a thousand feet, of nearly fifteen feet of concentrating ore, 8 feet 3 inches of which will average over 200 ounces to the ton. Below the surface showing 150 feet a 200-foot tunnel has been run in on the ledge which shows the ore body to be continuous.

The owners of the Black Diamond and Little Phil claims, in Ainsworth district, are running a joint tunnel to develop the two properties. The Black Diamond is owned by Chief Engineer Stevens of the Great Northern Railway, and the Little Phil by Captain Hayward and "Tom" McGovern.

The Mile Point claim below Ainsworth is developing into a mine, and G. B. Wright is correspondingly elated. The ore body is fully three feet wide, and the grade almost equal to the average from Slocan District. A shipment will be made to Tacoma this fall.

Miscellaneous.

The miners at the pits of the New Vancouver Coal Co. have acceded to the terms of the company and have returned to work.

The men at East Wellington Colliery are out on strike, demanding the same rate of wages as the miners in the employ of the N. V. C. Co.

The Stratheyre Gold Mining Co. is reported to be getting a satisfactory yield from their stamps at Fairview.

Owing to severe frosts diminishing the supply of water the Van Winkle Consolidated Hydraulic Company have shut down work on their claim near Lytton.

Hon. Col. Baker, provincial minister of mines, is expected home from China Creek on Sunday, when the latest information in regard to the rich Alberni gold fields, will be obtainable from an official source. Word has been received from Nanaimo, that a company has been formed there with a capital of $100,000, in $5 shares, to operate the Sandy and Gem claims, eight miles west of the Golden Eagle mine, on China Creek. Col. Baker, it is understood, has announced that an electric tramway will be built from the Golden Eagle to the head of the creek, where it joins the canal. A smelter will be erected at the terminus and the ore brought there over the tramway for treatment. Coal will be taken in from Union, and iron ore abounds on the canal banks.

CANADIAN COMPANIES.

The Similkameen Gold Gravel and Exploration Company, Ltd., held their first general meeting at the office of the company, last month. The reports of the prospector and engineer were read and are most satisfactory. The ground comprising 480 acres with 2 miles frontage on Similkameen River, is entirely free from boulders, clay or cement, and best of all the bedrock shows up for over a mile on the river bank, 40 feet above the river. The gravel is of a very good average throughout, in one shaft going as high as 33 cents per yard, and being well distributed throughout. The bedrock was struck in two of the prospect shafts. The engineer's report and estimate show the cost of laying on the water to be about $20,000, which was much less than expected. Not the least pleasing feature was the Secretary's report, which showed the cost of prospecting to be rather less than the estimated amount thus leaving a small balance in hand, a most unusual thing in mining ventures as several shareholders remarked. It is the intention of the company to push the work with all possible speed, as the extent and richness of the ground should make this one of the most valuable properties in the Province.

Siwash Creek Gold Mining Company.—This company was formed at Victoria, B.C., on 10th instant, to take over the benefits of three mining leases, dated respectively the 9th day of December, 1891, between George Christie Tunstall, Gold Commissioner, of the one part, and John P. Roddick, of the other part, recorded the 11th December, 1891, 26th January, 1893, and made between G. C. Tunstall, Gold Commissioner, of the one part, and Charlas T. Dunbar of the other part, recorded 22nd March, 1893, and the 25th day of January, 1893, and made between G. C. Tunstall, Gold Commissioner, of the one part, and J. C. Keith, recorded 22nd March, 1893; all now vested in William Farrel, E. Lindsay Phillips, and Charles T. Dunbar, subject to an agreement dated the 18th day of September, 1893, between the said Willian Farrel, E. Lindsay Phillips, and Charles T. Dunbar, and C. St. Aubyn Pearse, and Mount Stuart William Elphinstone, to carry on the business of mining in all that pertains thereto, and to procure, by purchase or otherwise, mine and work ores, minerals, and metallic substances, and compounds of all kinds, etc. Head office: Vancouver, B.C. Authorized Capital, $500,000, in shares of $10. The Trustees are: Chas. T. Dunbar, E. L. Phillips, B. T. Rogers, Chas. J. Lowean, C. St. A. Pearce, M. W. Elphinstone.

The Josephine Mining Company, Ltd.—This company has been registered, with headquarters at Nelson, B.C., and an authorized capital of $600,000. The objects for which the company is established are: To carry on the business of mining, milling, smelting, and reduction of ores of all kinds; to buy, sell, lease, or bond mines and minerals of every description within the United States and British Columbia; to erect and maintain mills, smelters, and all appliances for the reduction or handling of metals and minerals, and to do all things necessary or proper in connection with the foregoing objects as aforesaid.

Eureka Mining Company gives notice of application for charter of incorporation. Capital, $290,000, in shares of $1.00. The Directors are: James Heyden, Woodstock, N.B.; Frederick H. Hall, Grafton, N.B.; James Carr, Woodstock, N.B. Head office: Woodstock, N.B. The object for which the incorporation of the company is sought is—To purchase, take over, own and control the real estate, mining leases, rights, privileges, plant, machinery and property lately owned by the Britton Mining Company of New Brunswick, and to prospect, open up, develop, operate and mine on said property for gold and silver, or either of said metals, and to purchase and acquire such other real estate, mining leases, plant and machinery, as may be necessary for the prospecting, opening up, developing, operating and mining the same, or any part thereof, for gold and silver, or either of said metals, and to do such other acts and things as are incident thereto; and, if desired, after purchasing said property, or so much thereof as may be deemed advisable, to sell and convey the some, or any portion of the same, and to do such other acts and things as are incident thereto. The amount of the capital stock actually subscribed is two hundred and forty thousand dollars, and the stock so subscribed is to be paid for to the company by the transfer by the subscribers, of all their right and title in and to the said real estate, mining leases, rights, privileges, plant, machinery and property lately owned by the Britton Mining Company of New Brunswick.

International Asbestos Mining & Manufacturing Company has been organized under the laws of the State of New Jersey, to work an asbestos-bearing property of 130 acres, in the Township of Denholm, County of Ottawa, Que. Capital, $200,000, in shares of $100. Head office: John L. Armitage, Treasurer, (Prudential 928) Newark N.J. Officers: Herman Schalk, *President;* Otto H. Heinz, *Vice-President;* Frederick C. Preisel, *Secretary.*

The Drury Nickel Company, Ltd.—A meeting of the shareholders of this company will be held in the offices of the company, Township of Drury, District of Algoma, on Wednesday 6th December next, for the purpose of appointing a liquidator with a view to the winding up of the company.

The Ridgetown Citizens' Gas Company, Ltd, is seeking incorporation. Its objects are to sink and work artesian well, to explore for and procure natural gas or petroleum, and to supply the same for fuel and light to consumers, and generally to deal with the same, and for such purposes, with the consent of the parties interested, to lay down and work pipe lines for carrying and conveying such gas or petroleum or the product thereof, etc. The operations of the company are to be carried on in the County of Kent, in Ontario, and the chief place of business is to be in the Town of Ridgetown. Authorized capital, $24,000, in shares of $25. Henry Porter, Jas. McMaster, Jas. Henry Metton, Zenas Watson, K. Clinton Young, Richard Renwick Lothian, John L. Wallace, all of Ridgetown, are to be the first or provisional directors.

General Phosphate Corporation.

Meeting of Creditors—Directors Guilty of Gross Negligence—The Review's Premonitions Fully Borne Out.

The meeting of the creditors of this company was held on Friday, the 21st ulto., at Carey Street, W.C., before Mr. G. Stapylton Barnes, Official Receiver, the business being to appoint a liquidator and committee of inspection to act under the winding-up order made against the company in August last.

The accounts filed under the proceedings show total liabilities £130,682, of which £78,358 are expected to rank against assets, which are valued at £52,324, but are absorbed by the claims of the debenture bondholders. The account with the contributories shows a deficiency of £126,974.

The Chairman, in commenting upon the present position of the Company, dealing first with the original purchase of the properties, observed that, with a paid up capital of £39,000 the directors entered into bargains entailing an expenditure of £96,000, and left themselves without a single farthing for working capital, besides being very heavily in debt. There was very little doubt but that the prices of the properties were very much larger than ought to have been the case, having regard to the fact that phosphates had fallen to a very considerable extent. No valuation of the properties had been made, and the only two experts who were instructed to report as to value were gentlemen who had previously been employed by the vendors. Under these circumstances it was not too much to say that the experts' reports were not perhaps quite so independent as they ought to have been. In December, 1890, there was an attempt to issue further capital, with the result that £360 worth of shares was taken by the public. Then came the issue of debentures, which, in his opinion, seemed the most extraordinary piece of finance he had ever seen. There was a mortgage on the High Falls group of £30,000, subsequently reduced to £20,000, running to Oct. 31st, 1895. Upon the "Ross Mountain" group there was a mortgage of £27,500, also running to October, 1895. Although there was no necessity whatever to pay off those mortgages, which could have been running at the present time at the same rate of interest as charged on the debentures, the fact remained that £100,000 was raised, and a sum of £15,000 was paid to the Anglo-American Debenture Corporation (Limited), as commission. In respect of those debentures, the company only received in ready cash a sum of £5,410, but it was fair to add that they had derived other advantages, such as the payment of current interest, etc. A peculiar fact in connection with the debentures was that a further sum of £596 was paid out for law charges. Immediately following the issue of the debentures came a further borrowing of £20,000, although there were alternative courses by which money could have been raised on the uncalled capital, etc. They came next to the phase of the Company that might be termed the "North Star." When the Company was in great straits for money, and before they made their debenture issue, at a time that they were clogged up with their own properties and unable to develop them, they went and entered into an entirely new scheme which was commonly called the North Star scheme. That was an arrangement by which the Company agreed to combine with another company and purchase properties, with a view to reselling them to a company to be formed in the future. The result of that arrangement was the expenditure of nearly £8,000 by the Company, of which sum it was not likely that anything whatever would be recovered.

A few questions having been put and answered, resolutions were passed for the Official Receiver to act as liquidator and wind up the Company, with the assistance of a committee of inspection. Mr. F. J. Leslie, solicitor (J. and H. Gregory, Leslie & Hartley), Liverpool, was appointed a member of the committee to represent the interests of the creditors thereon.

MEETING OF SHAREHOLDERS.

The shareholders met later in the day at the Inns of Court Hotel, Mr. G. Stapylton Barnes again presiding.

The Chairman having repeated the information already given to the creditors, Mr. D. Johnson, a director who joined the Board so late as June, 1893, moved that Mr. W. O. Clough, chartered accountant, Gresham Street, E.C., should fill the office of liquidator. In moving the resolution, he criticised at great length the action and policy of the directors generally, and expressed the opinion that they had been guilty of negligence in the conduct of the Board's affairs, and that a searching inquiry was not only desirable, but absolutely necessary.

Mr. Smallman, a shareholder, seconded the nomination, and further commented upon the past history of the Company and the conduct of the business by the directors and officers.

Lord Stalbridge next addressed the meeting, and defended the action of the directors generally. He contended that throughout they had acted in the interests of the shareholders, and that their only object in raising money upon debentures was to prevent the properties in Canada being sacrificed by a forced sale. His lordship pointed out that although a statement had been made that the price of phosphate had dropped to 9¾d. per unit per ton, he was informed that the price was 11d. at the present time. After dealing in detail with the points raised by Messrs. Johnson and Smallman, his lordship concluded by stating that the directors had acted throughout to the best of their ability, and that all their actions had been directed by the wish to avoid the sacrifice of the properties by a forced sale.

Other speakers having addressed the meeting, a vote was taken on the question, and ultimately it was announced that as Mr. Clough had the majority of the votes of those present and the Official Receiver held proxies instructing him to retain the office of liquidator, the matter should be taken to the High Court later to be decided by the judge.

The Practical Treatment of Ores.

[Lecture at the Ballard School of Mines.]

Much of our national wealth and general prosperity depends upon the production of our gold mines. It is therefore desirable that when the ore has been raised every care should be taken to extract the whole of its products, and turn them to the best possible account. To this end it is necessary the persons in charge of operations should possess some technical, as well as practical, knowledge of all the best known methods of treating the various substances submitted to them. A knowledge of the technical part of the work can be acquired in the laboratories connected with the School of Mines, but the practical work must be obtained by actual manipulation at the mines or reducing works, as the case may be, where the products are prepared for the market; and the individual who possesses some previous elementary knowledge of metallurgy and the principles of mechanics will progress more rapidly and surely in his profession than his neighbor who is deficient of that knowledge, however skilful he may otherwise be as a workman. In England the extraction of metals from their ores is a work of chemical science, and every reducing establishment with any pretentions to importance has its staff of chemists and assayers constantly at work to determine the best and most economical methods of treatment for the extraction of all the products an ore may contain, and to discover in what manner these products may be applied to supplement or to supersede more costly substances employed in existing manufactures, and to to open up new industries for consuming the products won; and so keen is the research that scarcely a rock or pebble clay or ore that is not made to yield up its minutest treasures to the crucible and the flask. And this is the way I want to see the unbounded mineral treasures of this great country treated by the students of this Ballarat School of Mines. Very little need be said about the methods of extracting gold from alluvial mines. The whole treatment is based upon the principle of gravitation. Gold is nineteen and a half times heavier than water. It is, therefore, only necessary to reduce the clay portions of the *debris* with which it is associated to a state of solution to wash it away, leaving the gold deposited at the bottom of the tub or machine in which the reduction was made. The heavier and larger waste may be separated by screens or be removed with a fork, while the remainder is washed by panning, cradling, or sluicing, as may be most convenient. In Western Australia, where water is scarce, dry blowing is resorted to, but much fine gold is lost in this process. Mr. Theophilus Rhys, a former student of this school, and now manager of some important gold mines in the Murchison district, informs me there are large accumulations of dry blowings on that field which would pay well if water could be procured for washing them, and I suppose the same may be said of the Coolgardie field. There is one peculiarity about some alluvial gold which it may be important to notice. It is that which has rusty looking spots or splashes on it, apparently oxide of iron. It is in reality an oxide of manganese, and so far as I have noticed this peculiarity is seen only on gold found in or immediately adjacent to the older pliocene marine drifts, or, as miners term it, reef wash. These washes are usually found in isolated patches, high up on the banks of the leads, and hence they are called reef washes. Sometimes, as at Rokewood, the White Hills of Bendigo, and elsewhere in Victoria, they are not near any channel at all; and I may also mention that I have never seen nor heard of an instance in which gold marked with oxide of manganese has been found in auriferous quartz veins, and consequently I think we may fairly conclude gold so marked has not been derived from the breaking down of the quartz lodes. Of late years our output of alluvial gold has greatly fallen off, and we are consequently told these deposits are becoming exhausted; but there are hundreds of thousands of acres of this older pliocene marine drift entirely unexplored on the Victorian goldfields; and in many places where they have been worked here in Ballarat, such as the Red Hill, the Gum Tree Flat, Sir William Don, and elsewhere, they have produced more gold fathom for fathom than the best of our deep leads. It is this old reef wash which has turned out the biggest nuggets, and there are plenty more waiting to be unearthed as soon as the Mining Department can be made to understand the importance of mapping their field. Gold is found in lodes and veins associated with ores of lead, silver, zinc, antimony, iron, sulphur, arsenic, and other substances of a refractory character, all classed under the name of pyrites, its principal matrix being quartz. To separate the gold from these ores more complicated treatment is required than in the case of alluvial gold. The process is first to reduce the ore by crushing; and notwithstanding the numerous patents which have been introduced of late years, the old stampers have not been successfully superseded. The battery, as it is termed, usually consists of five stampers in one box, and each stamper, with its shank and disc, should weigh from 7 to 8 cwt. and be driven at from 70 to 80 blows per minute with a drop of 8 inches. The grates should be pierced at from 100 to 200 holes to the square inch, according as the gold in the stone may be coarse or fine. Each stamper will require a water supply of from six to 8 gallons per minute, or, say, from 600 to 800 gallons per ton of ore passed through. The false bottoms should be bedded in tailings up to within 1 inch of the bottom of the grates, so that the crushed *debris* can get away as quickly as possible when it is sufficiently reduced to pass through the grating. Immediately in front of the grate suitably dressed copper plates should be laid down the full length of the stamper-box—say 6 ft. long by 3 ft. wide—and having a pitch of three-quarters of an inch to the foot. After passing over this plate the *debris* should drop into a well or trough (the full length of the plate) 3 in. wide by 2 in. deep, and having a baffle slip or board on edge close down on the surface of the quicksilver, with which the well is to be filled, to within half an inch of the top. This baffle slip distributes the flow of the *debris* over the whole face of the quicksilver before passing on to a second copper plate and well, similar to the first. After this second plate and well, there should be about 12 ft. in length of blanket strakes, having a pitch of one inch and a half to the foot. I have tried every description of fabric for the purpose, and find gunny bags to be the cheapest and most effective. Lay them down without cutting just as you get them, with the mouth toward the low or discharge end of the table. These should be taken up and washed out every two hours. While the crushing is going on it will be found advantageous to put 2 or 3 oz. of quicksilver into the stamper-boxes with the feed every three or four hours. I have tried various methods of dressing copper plates, including electroplating with pure silver. The dressing I prefer is as follows—First, clean the plate thoroughly with a hot solution of caustic soda or American potash, (do it with a swab, don't put your hands in it); then make up a dressing (say for a plate 6 ft. x 3 ft.) composed of 2 lbs of quicksilver, 4 oz. sodium amalgam, 3 oz. fine gold amalgam, and ½ oz. cyanide of potassium—be careful of this cyanide, it is only another name for prussic acid, a deadly poison—place the whole in an enamelled basin, pour on to it nitric acid, gradually stirring with a glass rod (a boiler gauge glass will do) until the whole assumes a thick creamy consistency; then fasten a strip of leather or india rubber about 2 in. wide over the rounded end of a piece of wood, which use as a rubber to distribute the dressing all over the face of the plate. It will adhere readily like a coat of paint, and will now be ready for use. The fine gold from the stampers will accumulate quite freely as an amalgam, and may be removed as required with a scraper; the plate should not be scraped bare, or it will need redressing. After about six months' use the plate, should be scaled to remove the accumulated gold, which cannot be collected with a scraper in the ordinary way of collecting the amalgam. There are different ways of scaling the plate. One way is to lay a close cover, about 6 in. deep, over the plate, weight it down with four or five false bottoms, then turn on a strong jet of steam through a hole in the cover, which will have the effect of driving off the quicksilver and blistering the gold scale, so that it can be stripped from the face of the copper sheet. Another plan is to heat the plate over the fire until the mercury begins to volatise, and then remove as much as possible with a steel scraper. I do not like this process—it is decidedly dangerous to the operator. I have seen men suffer great prostration and salivation, which made all their teeth loose for days. The process I prefer is as follows:—Place the plate, supported by a few bricks, over an open fire until it assumes a dull red heat; by this time all the mercury used in the dressing, and accumulated from the battery, will have fumed off. Then remove the plate from the fire, and, when it has cooled, wash it all over twice with dilute sulphuric acid. Let it stand over night. Then place it on the open fire again, until it assumes a rather brighter heat than on the first occasion; and, now, while it is on the fire, cover the whole surface of the plate, over ½ in. deep, with a half-and-half mixture of sal ammoniac and common salt. Let it fizz until it ceases, then remove the plate from the fire, and when cool the gold scale can be easily removed like a sheet of brown paper. This roasting anneals the plate, which must be again re-dressed, as in the first instance. I have taken as much as 70 oz. of gold scales from a single plate in this way after it had been in use only six months. This scale, of course, contains several ounces (per 10 oz.) of copper. To flux that copper out in the melting-pot requires some hours' work. I find the best way is to boil the scales with nitric acid in an evaporating pan over a sand bath. My sand bath is an old frying-pan filled with sand placed over an open fire in the retorting chimney, or on the top of the melting furnace. I like the chimney best, because of the resulting fumes, which makes one feel like influenza. Place the evaporating dish (china is best, but an ordinary yellow crockery one from the Lal Lal pottery will do) in the sand, throw in the gold scales, and cover with nitric acid. When the copper flumes cease to rise the scale will be ready for the melting-pot. I mentioned sodium amalgam as being one of component parts of the plate dressing. There are two ways of making sodium amalgam. One is to place, say, 2 oz. of the metal sodium, together with 7 lb. of mercury, in an ordinary iron retort, put on the fire, and as soon as the mercury shows indications of coming over, remove retort from the fire, and let it cool before opening—the result will be sodium amalgam. I prefer the following plan:—Place the mercury in an iron basin, over a dull fire, and as soon as it begins to warm, add the sodium in small chips, while stirring the mercury with a glass rod. When all the required sodium has been added, remove the dish from the the fire, and let it cool—the result will be a good firm sodium amalgam. The *debris* collected on the blanket-tables is usually treated with mercury, in a revolving barrel. The charge should not exceed one-third of the capacity of the barrel, and the mercury should not exceed one-third of the capacity of the barrel, and mercury should be equal to about one-fourth of the weight of the *debris*, which should be mixed with water to the consistency of bricklayer's mortar, and be worked in this state for about two hours and a half. During this stage the barrel should revolve from seven to nine revolutions per minute; after which, half fill it with water (warm water, if convenient), add 2 or 3 lb. of slacked lime. Then work it again for about two hours, driving the barrel twelve revolutions per minute; after which, wash off in a shaking table, cradle or other available appliance. A chamois leather is generally used for squeezing the mercury out from the amalgam, but a double fold of unbleached calico will do just as well, and is less costly.

Sir George Elliot's Projected Coal Trust.

A scheme for the consolidation and common working of all the coal interests of the United Kingdom has, after years of consideration and consultation between coal experts and other eminent authorities, been laid before the public. The name of Sir George Elliott, who is the proposer and originator of the scheme, is too well known to call for comment. There is perhaps no one in Great Britain who is better qualified by practical experience to take the position of leader in the movement which he has initiated. He claims that the object of the great change which his scheme seeks to encompass is in no way the creation of a monopoly or trust for the sole benefit of the proprietors, but a combination which shall be a benefit not only to the coal-owners, lessees, workmen, and consumers, but to the nation at large. It is on this level that the scheme challenges consideration, and in so far as it makes good its right to this high ground, it ranks for judgment among the great political and commercial conceptions of the day. It requires no political sanction for its formation. The co-operation which it needs for success is in the first instance solely the co-operation of the coal lessees of the United Kingdom, who are invited to exchange their interest in the properties at present worked by them for shares and debentures in a United Coal Company. This company shall then undertake the working of the entire coal deposit of the country, with all the attendant responsibilities involved by the employment of so vast a body of labor, and the sole command of the home supply of fuel. The scheme works out in ably devised detail the conditions under which it is proposed that such an amalgamation of competing interests should be accomplished.

The present yearly output of the coalfields of Great Britain is 182,000,000 tons, which, at an average selling price of 7s. 3d. a ton, represents a gross value to the coal-owners and lessees of £65,975,000 per annum. From this £54,600,000 must be deducted to cover the average cost price of 6s. per ton at the pit bank. The remaining £11,375,000 represents roughly the profits which may be made under the present system of working by the coal lessees. About 20 per cent. of the quantity of coal now produced is consumed in the working of ironstone and in the manufacture of iron and steel. As a great deal of this is raised and worked by the ironmasters themselves, who would evidently have nothing to gain in joining a scheme based on any general principal of profit-making, it has been left out of consideration, and the calculation is based on a present annual output of 145,000,000 tons. It is estimated that the sum required to represent the whole capitalized interest of the lessees would be slightly under £110,000,000. This figure does not greatly exceed the share value of the London and North-Western or even of the Midland railway, and, in view of the fact that the amalgamated value of the railways of Great Britain would come to nearly £900,000,000, it will probably be a matter of surprise to many people to learn that the capitalized

value of the amalgamated coalfields would be so relatively small. The capital sum to be dealt with, although considerable, is not therefore of such unmanageable magnitude as the first thought of a consolidation of the coal interests of the United Kingdom would suggest. The basis of co-operation on which it is proposed to carry out the scheme dispenses with the necessity to raise any greater portion of this sum In cash than may be required to free the collieries from present obligations. For this purpose it is proposed, probably with some foreknowledge of the chances of carrying out such a droposal with success, that a body of bankers shall be formed who shall agree to take debentures, at a price to be agreed upon, from any colliery proprietor, to an amount not exceeding one-third of those allotted to him. It is a further detail of this proposal that anyone so applying for the exchange of his debentures into cash should set aside an equal amount of his shares, giving to the bankers the option of 12 months to take the same at par. The total amount of cash required will not, it has been estimated, be likely to exceed the provisions thus made for it.

The figures disclose nothing impracticable in this part of the scheme. The question of its working feasibility turns mainly upon the advantages which the coal lessees might hope to gain in return for their co-operation. Many of these advantages are obvious. In the first place, as a united body owning the whole coal wealth of the country, they would—paradoxical as the statement may at first sight seem—have a larger mass of available coal in their possession than any added computation of their individual properties would now give. A lessee under existing conditions is obliged to leave on the boundary of his royalty a solid rib of coal varying in width from 40 to 100 yards, which is a total loss alike to himself and to the nation. A consolidation of royalties, doing away with the necessity of boundaries for any but engineering purposes, would bring nearly the whole of this coal into the market, and, together with the facilities which a different method of working would give for the hauling of small coal now allowed to go to waste, would, it has been estimated, add fully ten per cent. to the annual output. This would mean, if all other conditions remain as they are, an increase of 10 per cent. upon the existing collective profits of the coal trade. But the saving in coal itself is only one of the economies which the substitution of co-operation for the present system of competitive development might be expected to introduce. The expenses of pumping, ventilation, and underground haulage are among the most considerable items of cost in process of raising coal. All of these might, it is claimed, be much reduced if the area to be treated were regarded only in the light of the physical peculiarities, and dealt with without consideration of arbitrary divisions. Briefly, the effect of amalgamation, it is contended, would be to remove all the artificial factors which now stand for so much in the sum of the coal mining industry, and to leave science and nature face to face.

With regard to management, it is proposed to create a central representative council, the unit of representation being a given number of tons of coal. Under this central council it is proposed to create about 30 district committees, which would be immediately concerned with the working of the collieries and local business of their respective districts. These committees would also be elective, and would consist of representatives chosen in a fixed proportion by the shareholders and the miners. The district committee would absorb and take over the duties of numerous existing boards of directors, and thus cause a considerable ultimate saving.

The appraisement of existing values in coal properties has been looked upon as in some respects one of the most practical of the difficulties to be met. It has, however, to be borne in mind, that such appraisement is at the present time constantly made for purposes of sale or for division rendered necessary by the death of a colliery proprietor. It is believed that a fair estimate or annual output calculated at 15s. a ton will be found to represent the capital value of the entire coal beds of the United Kingdom.

The labour which is directly employed upon the coal properties of Great Britain amounts to something not far short of a million of men. The interests of a million of human beings, who with their wives and families dependent upon them, may be estimated to form nearly an eighth part of the population of the kingdom, have a weight and importance which the dislocation of industry that has followed on successive strikes does not allow any of us to forget. Sir George Elliot has studied the coal industry on every essential side ; he has a right to speak with authority upon the needs, the aspirations, and the fair requirements of the great body of English miners, and it is from the point of view of the enlightened pitman that the proposals which affect the workman's share in the new scheme have been conceived. They are put forward with a confident assurance that their adoption will relegate strikes to a closed chapter of the history of the coal trade.

The principle of admitting the claims of labor to share with capital in the profit-earning power of industrial enterprise is accepted wholly in a clause of the scheme which includes a certain limited interest upon capital as part of the working expenses, and provides that the workmen shall share equally with the coal lessees in any further profit that is made. Nothing in the scheme is more interesting and novel than the section which deals with the division of profits. The interests of the public are more directly safeguarded by a clause which admits the consumer to immediate participation in the benefits of the economy which is contemplated. The scheme accepts in its entirety the principle of the limitation of interest, and one of its essential conditions is the provision that the price of coal shall never be raised above the figure which is required to give an interest of 5 per cent. upon the debentures, and to reach a *maximum* of 15 per cent. upon the stock, without the sanction of the Board of Trade. It has been estimated that an everage selling price at the pit bank of 7s. 3d. a ton at the present annual rate of output would suffice to give the interest required. The purchaser, it is claimed, would thus be protected from the possibility of extortionate prices in the future, and in order to give full effect to this guarantee, it is proposed to invest the Board of Trade, either in the articles of association of the company or, if necessary, with Parliamentary sanction, with all functions essential to the exercise of its arbitrating powers. It is believed that, when there is but one salesman for coal throughout the country and the prices of that salesman are regulated by a decision of the Board of Trade, the fluctuations of retail price must be greatly checked, and the creation of agencies of distribution where coal could be obtained at a fixed published rate would be, like the distribution of water, a mere question of subsequent organization.

Fan-testing Guages—Some notes on fan guages in connection with fan-testing and the adaptation of fans to mines, and also a comparison of the fan and furnace at Silver Hill colliery, are given by the Rev. G. N. Capell (Transactions of the Federated Institution of Mining Engineers, vol. iii, pp. 196-200). It is considered that the most satisfactory position for taking the gauge is 6 to 10 feet away from the inlet in the larger part of the fan-drift. The German practice of deducting the works of the air due to its velocity is not considered fair. After many observations, the author advises that the end of the guage should be plugged with cotton-wool and wrapped with soft flannel ; but definite rules for the position and use of water-guages ought to be drawn up and adhered to in all fan-tests. Where fans have taken the place of furnaces, some curious results have been observed, and this may arise from the fact that the guage in furnace ventilation does not account for the shaft friction in the up-cast and down-cast shafts. Direct calculations probably give too high results for these factors. The author then proceeds to give the results of some tests with furnace and with fan ventilation to illustrate the difference in the guages obtained by the two methods.

The Ventilation of Lignite Mines—C. Balling (Uber das zur Ventilation von Grubenbauen erforderliche Lauftquantum, &c., by C. Balling, Teplitz, 1891 ; Oesterreichische Reitschrift fur Berg-und Huttenwesen, vol. xl, pp. 101-104) discusses in detail the question of colliery ventilation, referring more especially to lignite mines. He refers in the first place to the quantity of air required at different temperatures for breathing, both by men and horses, then to that used for lamp combustion, to the absorption of oxygen by the coal, and by various animal and vegetable matters existing in the colliery. Next the question of hydrocarbons, sulphurous anhydride, ammonia, carbonic oxide and carbonic anhydride of the colliery atmosphere is considered. The influence of the temperature of the workings on the power of the workmen to perform labor is stated to be as follows :—

Rise of Temperature.	Diminution of Work done.
From 20° C. to 25° C.	5 to 10 per cent.
" 25° C. to 30° C.	10 to 15 "
" 30° C. to 35° C.	15 to 30 "
" 35° C. to 40° C.	30 to 50 "

At a depth of about 15½ fathoms there is an equal temperature all the year round, and for every 15½ fathoms increased depth there is a rise of 1° C. Even a very rapid current of air will not diminish this temperature to any marked degree. The temperature of the workings is also dependent to a considerable extent on the body heat of the men and horses in the mine, and on the combustion of the oil used in the lamps for lighting purposes. By doubling the quantity of air used, in an example given the temperature was only reduced from 24·7° to 23·7°, and then the velocity of the air current had become so great that a further reduction of temperature by this means had become impossible.

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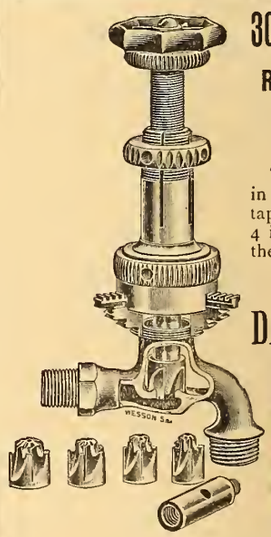

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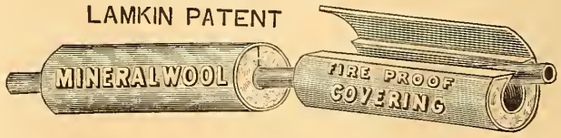

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Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

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Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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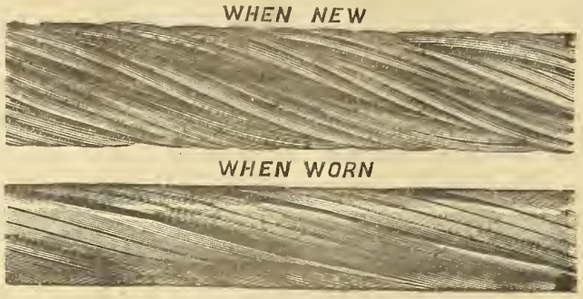

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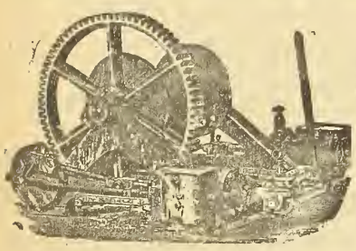

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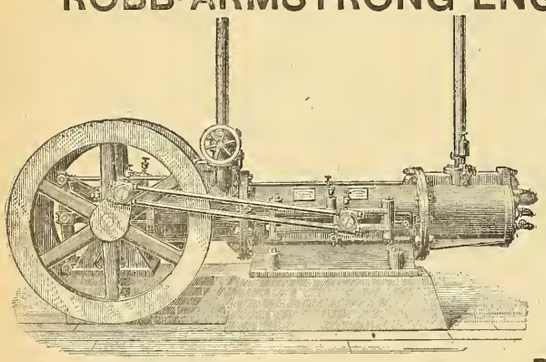

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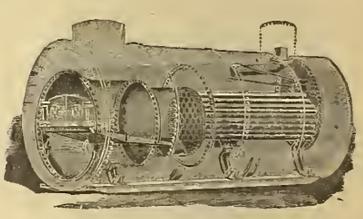

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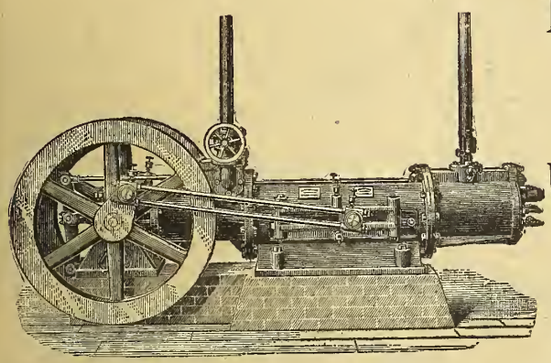

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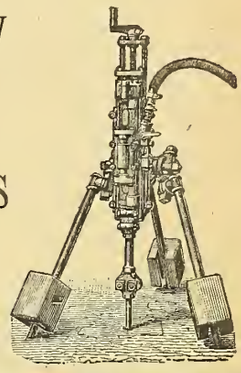

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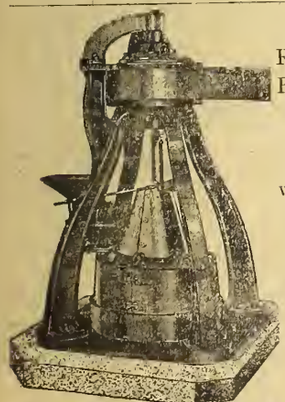

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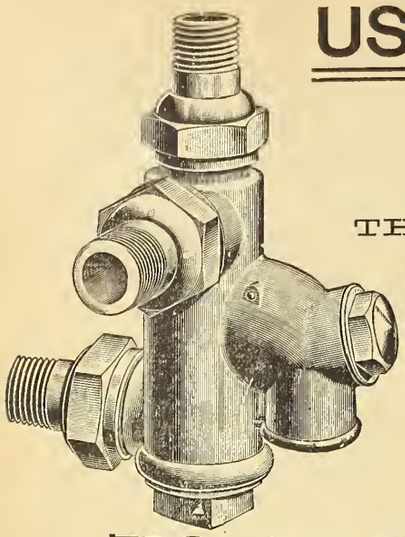

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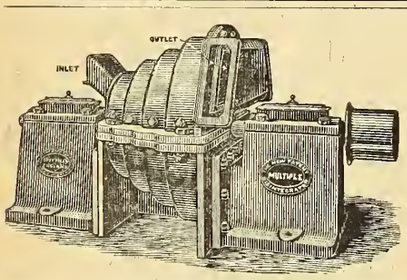

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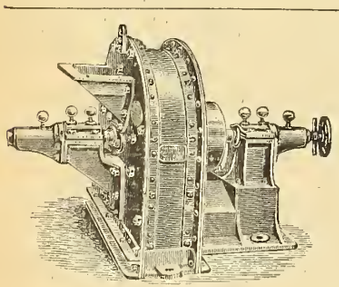

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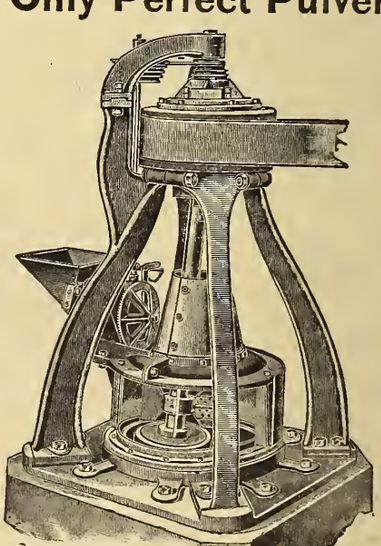

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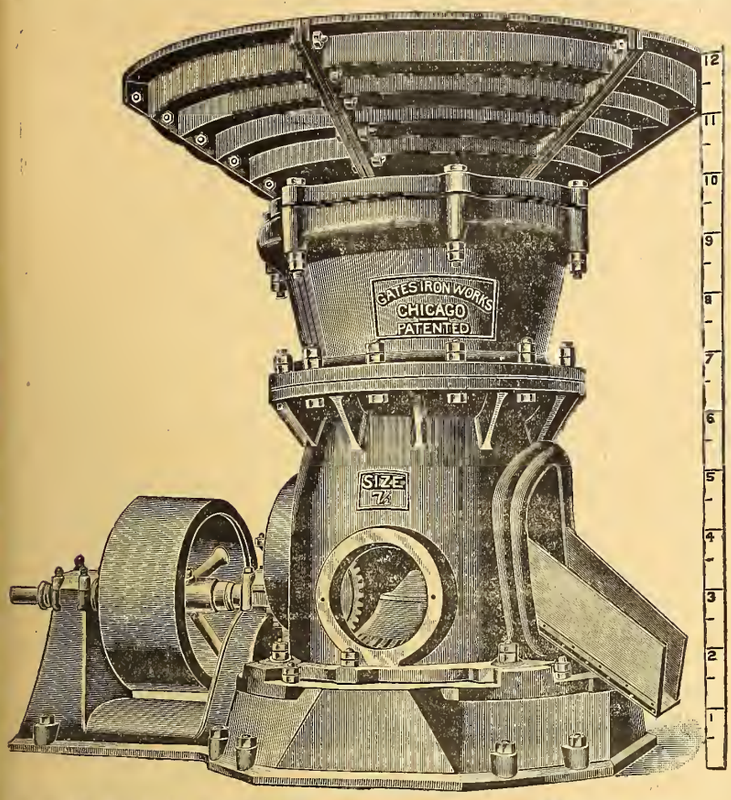

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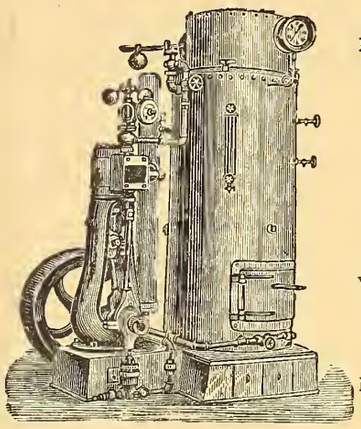

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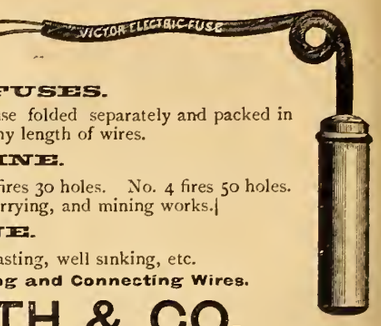

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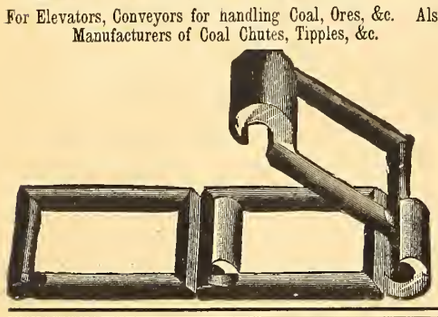

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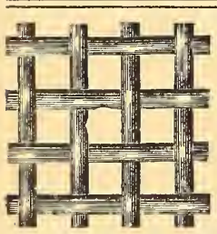

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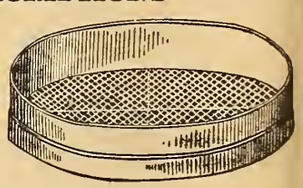

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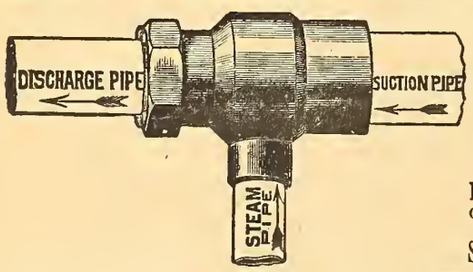

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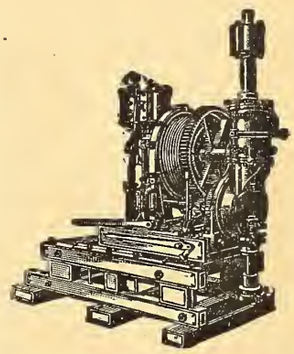

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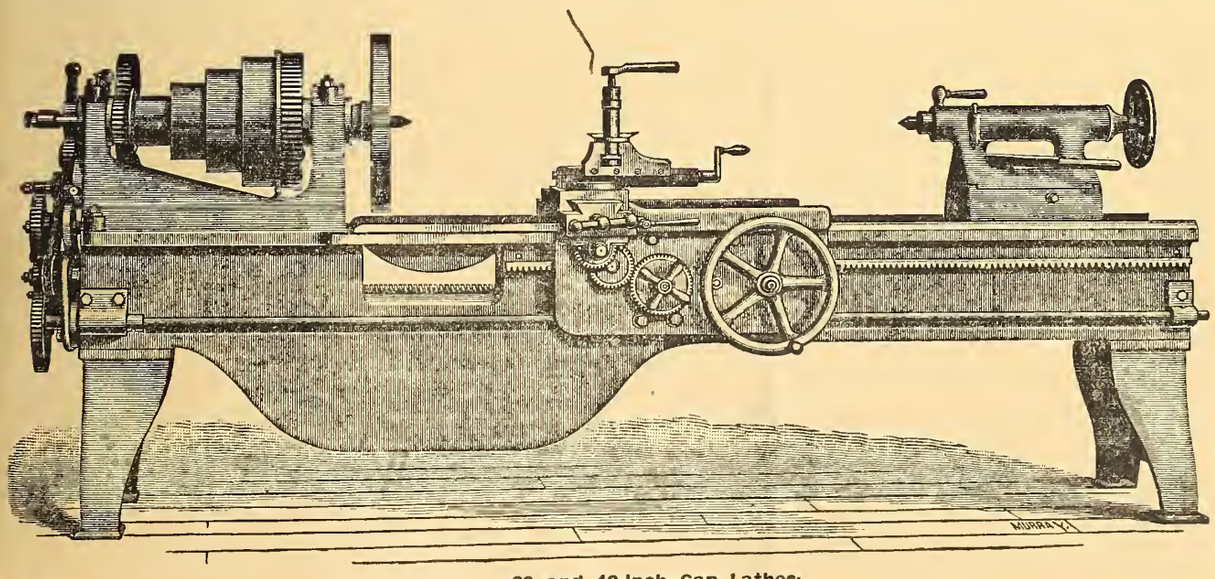

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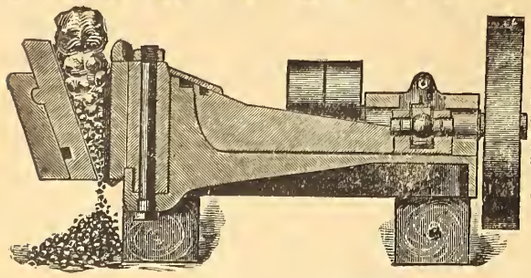

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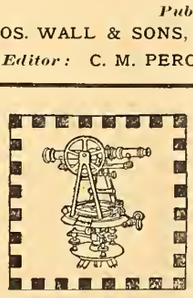

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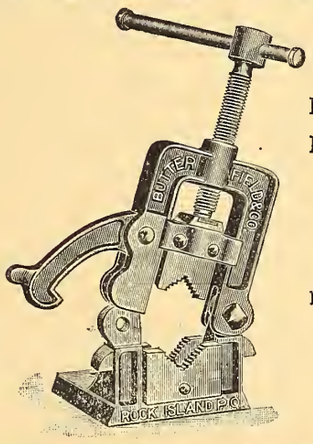

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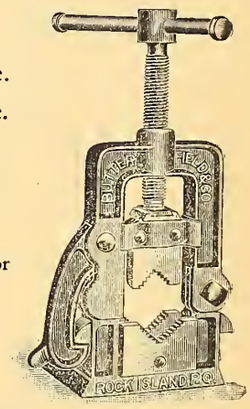

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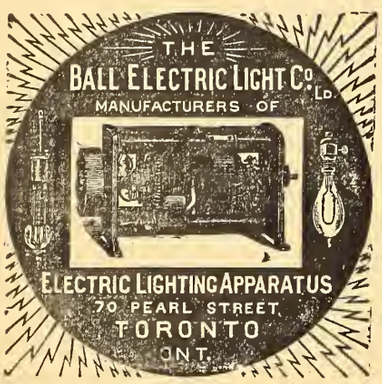

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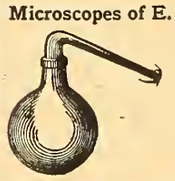

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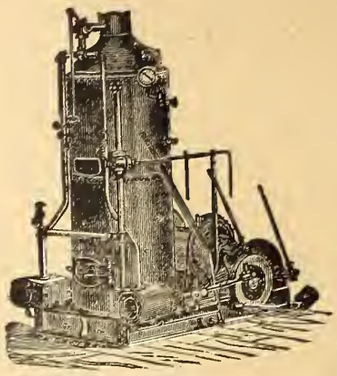

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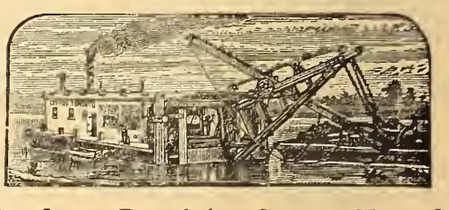

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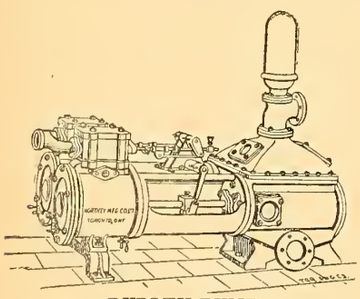

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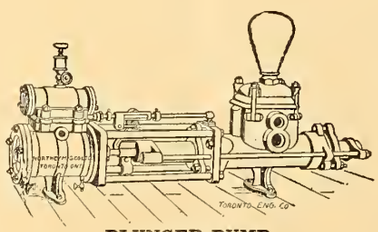

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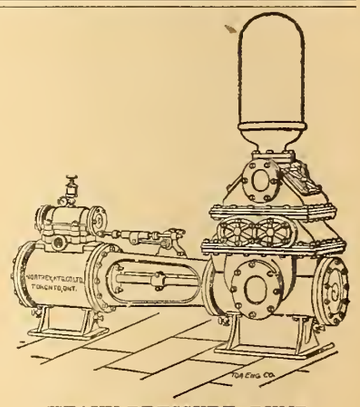

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THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEBEC.

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. XII. DECEMBER, 1893. No. 12.

The Free Coal Question.

It is amusing to read the articles written both in Canada and the United States on the free coal question and to note how they vary in agreement and conclusion with the interest of parties; how facts and fiction, partial truth and mere assumption are blended together. Taking the experience acquired by the trade previous to the termination of the Reciprocity Treaty in 1866, one party argues for certain results as sure to follow; another contends that the course of trade cannot revert to the old channels of 1865, when New England took some 465,000 tons of Nova Scotian coal, yet again we are told in Boston the coal is no good anyhow. Even Mr. Edward Atkinson, a year or so ago, was made to say that coal from Nova Scotia was very liable to spontaneous combustion and hence was undesirable. Lately, we were glad to see in the Boston *Herald*, that he disclaimed this sweeping assertion which could not be sustained. The experience of years has shown that if only ordinary precautions are observed there is no liability; and the precautions are, storage in drained ground free from wood and hot boiler walls.

That the prospect of free coal is dreaded by many is to be expected; no changes in the Tariff can take place without disturbance of Trade, and loss to some dealers and operators, but we regard the alarm from the west as wholly imaginary. In 1866 Western Virginia had no cheap rail connection with the coast, now excellent bituminous coal can be bought on the seaboard for $2.25 per ton and it can be carried northward to New England in barges at half the present rate of freight from Cape Breton coal ports. Then the understanding that now exists among the railways makes the charges of water-borne coal carried inland vastly higher than on an all-rail route. This must effectually limit the possible area in which the so-called cheap coal of Cape Breton can compete, and when realized silence the anxiety of the West.

In Nova Scotia anxiety is felt lest the removal of the duty on coal entering the United States be followed by a remission of the duty on coal entering Canada, when not only would American coal take all the market west of Montreal, thereby reducing the business at that point some 200,000 tons, but English and Scotch coal brought out by the ocean steamers at ballast rates would take 150,000 to 200,000 tons additional. The Nova Scotia collieries being thus beset both before and behind would positively lose the benefit of the St. Lawrence market and have only the problematical benefit of what they might capture in the United States.

The imposition of a protective duty has greatly stimulated the production of coal in Nova Scotia, the output of the mines of that province having increased from 882,863 tons in 1879, to 2,175,193 tons in 1892. Sales of Nova Scotia coal to the Province of Quebec having in the same period risen from less than 100,000 tons to over 750,000 tons annually. At the same time it must be said that the importation of coal from the United States in the Province of Ontario has enormously increased in spite of the duty of sixty cents a ton.

In British Columbia the interests are not so complex as on the Atlantic seaboard. So far as it is concerned the removal of the duty would be of unquestionable advantage, because its production is practically illimitable and far exceeds the home consumption and under no circumstances would coal be imported. British Columbia intends to keep and to extend the large sale of her coal in San Francisco and other American points on the Pacific Coast. Of late, supplies have been drawn to San Francisco in competition with British Columbia, but the quality of the coal has been proved to be much inferior to that from Vancouver Island and it is not possible to doubt that if the duty is removed by the United States a great impetus will be given to the sale of coal from this province.

EN PASSANT.

The existing tariff on imports of lead ores into the United States is one and a-half cents per pound on the amount of lead in the ores. The silver lead ores of the Kootenay district contain from 40 to 75 per cent. of lead so that each ton of ore pays a duty of from $12 to $22.50. Under the Wilson Bill ores in which the silver value is greater than the lead value will be admitted free. A ton of ore containing 100 ounces of silver and 50 per cent. of lead with silver at 70 cents per ounce, and lead at 3¾ cents per pound, would have a silver value of $70, and a lead value of $37.50 and would pay no duty, whereas an ore assaying 75 per cent. of lead worth $56.25 to the ton and carrying only 80 ounces of silver, worth say $56

THE ST. LAWRENCE COAL TRADE.

The returns of the quantity of bituminous coal deliveries by water to St. Lawrence ports during the past season are now complete and show a very satisfactory increase over former years. The total importation amounts to 737,941 tons, as against 626,087 in 1892. Previous figures show: 1885, 360,000 tons; 1886, 377,500 tons; 1887, 482,103 tons; 1888, 517,539 tons; 1889, 467,525 tons; 1890, 543,656 tons; 1891, 602,323 tons.

The figures in detail for the past season are:—

NAME OF MINE.	MONTREAL.		SOREL.		THREE RIVERS.		QUEBEC.		TOTALS.	
	1892	1893	1892	1893	1892	1893	1892	1893	1892	1893
Dominion Coal Co	337,183	466,005	7,436	5,191	.....	.....	27,576	18,137	372,195	489,333
General Mining Association ..	75,547	75,195	1,589	11,494	9,012	9,218	30,472	33,500	116,620	129,407
Intercolonial Coal Railway...	79,155	72,084	4,566	.....	.....	.....	.....	.....	83,721	72,084
Scotch and English.....	32,876	36,074	3,103	1,528	... ..	.....	17,572	9,520	53,551	47,122
Season 1893.....	524,761	649,358	16,694	18,213	9,012	9,218	75,620	61,157	626,087	737,946

to the ton, would have to pay a duty. Most of the ores in the Kootenay district will class as silver lead ores in which the silver value predominates. But there are some large deposits of galena on the shores of Kootenay Lake, notably in the Blue Bell mine, which are high in lead and very low in silver and these will not be able to work profitably in the face of any duty, although the Wilson Bill proposes to reduce the lead duty.

It is evident that a saving of $15 to $20 on every ton of ore shipped is a profit in itself and this change if carried out must be of great advantage to all the high grade silver-lead mines and will give a decided stimulus to mining in the Kootenay district of British Columbia.

The Logan Club, an organization composed of the staff of our Geological and Natural History Survey held a highly successful dinner in the Russell House, Ottawa, on the 14th inst. About forty were present. At the request of the committee in charge, who desired that the proceedings should be private, the REVIEW regrets to be compelled to withhold from its readers a report of what took place. This is all the more regretable as in the many excellent speeches of the evening much was said of interest respecting the urgent necessity of enlarged and more secure accommodation for this branch of the service and particularly for its magnificent collection of national treasures. Surely in view of the dangerous condition of the present building, it is full time the Dominion Government made a move to erect a building more in keeping with the enlarged sphere of the Survey and the national importance of its work. No appropriation could be better spent in the interests of the country.

The General Mining Association of the Province of Quebec commences the fourth year of existence with a series of meetings of an unusually interesting nature at Montreal on 10th and 11th January. Three sessions will be held and many valuable papers will be submitted for discussion. The annual dinner will be held in the Windsor Hotel on Thursday evening, 11th prox. We trust there will be a large attendance to inaugurate a new year's work.

The *Journal* of the General Mining Association of Quebec containing the Transactions of that body for the years 1891-2-3, has been published and issued to members. In some 450 pages is contained a mass of valuable literature respecting the mining practice and mineral resources not only of the Province of Quebec, but of the Dominion at large. Of particular service should prove the history given of the fight against the Mercier Mining Act and other legislative enactments which have proved a feature in the work of the Association. The volume is handsomely gotten up and is carefully indexed for reference.

In these degenerate days, when one of the loudest laments has for its burden the disinclination of young men to marry, some comfort is derivable from an advertisement like the following reproduced from the *Australian Mining Standard*:

> WANTED.—By Gold Prospector, Queensland, tidy Girl, used to camp life, view to matrimony; genuine. Address———

This should cause the heart of many a hopeless maiden to glow again, and open up vistas of prospective happiness in the sylvan shades of far off gullies in Bananaland. The ambiguity of the advertisement gives free range to the imagination, but this may not be altogether an advantage under the circumstances. The advertiser is not very clear as to the conditions of the probation he indicates, and perhaps some coy damsels might hesitate even to make enquiries while there is the faintest suggestion of a compromising situation. From the assurance of the advertiser that his communication is "genuine," it would almost appear as if he anticipated some doubts occurring to timid minds, but it is to be hoped that any want of clearness in the advertisement will be compensated for by the "correct" answers of the advertiser to the enquiries of any "tidy girl" who may yearn to lay her head on the manly bosom of a gold prospector in Queensland.

But the efforts of the bold Queensland prospector to get a wife on approval, have been discounted by another aspirant of the male sex, who, if we may believe the same authority, advertises as follows:—

> MINING EXPERT (bachelor) having discovered very rich gold mine, wants to meet young woman or widow willing to risk £20 to develop the mine, which will probably result in thousands of pounds profit; half-share or marriage. Fullest particulars on application, in strict confidence.

Here is surely a golden opportunity. It should be a game of "heads I win tails you lose" for the lady, for a decent husband would be cheap at the price, to say nothing of the prospect of thousands of pounds from the mine. A suspicious feature about the announcement is the apparent indifference of the advertiser whether he enters the bonds of matrimony with his fair partner or only goes shares, but this may arise not so much from want of desire to link his fate irrevocably with the other member of the firm as to give a chance to ladies to whom marriage would be out of the question.

The *British Medical Journal* publishes a communication from Dr. Fray Ormrod drawing attention to the occurrence of lead poisoning among men engaged at blast furnaces, in which that peculiar form of cast iron which goes by the name of "Spiegeleisen" is produced. This is largely used in the Bessemer process for the manufacture of steel, and is got from a considerable variety of ores, some of which are apt to contain an admixture of lead. When this flows from the furnace, either with the slag or with the reduced metal, it becomes oxidised, and rises in a dense yellowish white fume, containing 94.5 to 74.5 per cent. of lead oxide. This is very poisonous, and to it the men who are engaged at the "slag-holes" are exposed during almost the whole of their working day, and those on the "pig beds" at the time of casting, that is every four or five hours. All these men are apt to suffer from lead poisoning, often suddenly and severely. After a three weeks' holiday it was noticed that four men were soon disabled; A, after working seven shifts, B and C three shifts each, and D four shifts. Some men have been laid up for a fortnight at a time, at least a dozen times in two years. Obviously the men engaged at these furnaces are exposed to even greater dangers than ordinary lead workers, in consequence of the much greater tendency of the metal to volatilise at the higher temperature required for the reduction of the iron.

In an address, at Newcastle, Professor Philipson, the President of the British Medical Association, said that to the heated atmosphere of the coal mine, an atmosphere often laden with dust, and to the strain thrown upon the internal organs caused by the cramped position in which miners are obliged to work, the mucous catarrhs of the respiratory and gastro-intestinal tracts, from which miners suffer, may be attributed. But there are few diseases peculiar to miners. Anthracosis is very rare. Emphysema of the lungs does occasionally occur. The pitman's asthma is well known, but it is a much less frequent disorder now than formerly. Miners are also very exempt from nephritis, which may be attributed to the profuse perspiration which they experience while at work, and to the daily ablution which they practice on their return home. Contrary to what might be expected, rheumatism and rheumatic fever rarely effect the coal miner. The miners of the north of England have an average of three years longer life than the aggregate of Englishmen, eight years longer than the Cornish miners, nine years longer than the South Wales miner, and only one year less than that of the men of the healthiest districts of the kingdom.

The £20,000,000 worh of gold now mined annually is not nearly enough (says *Science*) to meet the world's requirements. The yearly wastage of this metal is enormous. Various kinds of gilding consume a great amount of it. It is reckoned that in Great Britain alone 25,000 oz. more are employed in the same length of time for manufacturing gilt buttons. The finest buttons of this description are produced by applying the gold in the shape of fine dust mixed into a paste with quicksilver. The mercury causes the gold to adhere to the base metal, after which it is evaporated by heat, leaving the gold on the surface. Large quantities of pure gold are utilised for the plating of other metals and for ornamental pottery; but by far the greatest waste of gold is incidental to its uses for jewellery, which consumes more than three times as much of the metal as is coined. Not less than £6,000,000 worth of gold is devoted every year to making articles of ornament. Nearly all of this is eventually lost, not more than one-fortieth of it ever returning to the hands of refiners or manufacturers. With gold

coins the loss by abrasion in the process of circulation is very considerable.

Following up the REVIEW'S repeated advocacy of the development of the great iron resources of Ontario, the *Canadian Manufacturer* contains an interesting leader on the subject in its last issue in which it emphasises the necessity of putting a stop to the importation of scrap iron, by the imposition of a heavy prohibitory duty. But the *Manufacture* is wholly in error when it states that this very important phase of the manufacturing interest has been overlooked by the REVIEW. If our contemporary will refer to some of our back numbers it will find that we are quite at one with it in the opinion "that the duty and bounty on pig iron remaining as they are, and the duty on bar iron remaining unchanged, with a prohibitory duty on scrap iron our blast furnace industry would be very quickly developed."

Our esteemed contemporary has also an article on the attitude of the mining men of the country, on the interpretation of the law respecting the admission of free mining machinery. For want of space we are compelled to defer our reply to this until next month. In the meantime the *Manufacturer* would do well to post itself correctly as to what the mining men really want, before giving prominence to the distorted inspiration of some sorehead who evidently desires to own the earth.

QUARTERLY MEETING

OF THE

Mining Society

OF

NOVA SCOTIA.

The December Quarterly meeting of the Society was held in the Rooms of the Society, 129 Hollis Street, Halifax, on the 1st December. Among those present were: S. H. Poole, M.A., Stellarton, N.S.; John E. Hardman, S.B., M.E., Oldham, N.S.; David McKeen, M.P., Sydney, C.B.; R. H. Brown, Sydney Mines, C.B.; F. H. Mason, F.C.S., Truro; B. C. Wilson, Waverley; T. R. Gue, Halifax; B. T. A. Bell, Ottawa; G. W. Stuart, Truro; D. Turnbull, Sheet Harbor; Charles Archibald, Cow Bay, C.B.; C. E. Willis, Halifax; H. G. Stemshorn, Mooseland; John H. Austen, Halifax; Duncan MacDonald, Truro; A. A. Hayward, Waverley; W. Blakemore, Cardiff, Wales; J. J. Penhale, Black Lake, Que.; G. E. Francklyn, Halifax; W. Lithgow, Halifax; Hugh Fletcher, Ottawa; R. G. E. Leckie, Torbrook, and H. M. Wylde, Halifax, Secretary.

Mr. H. S. Poole, M.A., A.R.S.M., President, who occupied the chair, called the meetiug to order at 11 a.m.

The Secretary read the minutes of the previous meeting which were confirmed.

New Members.

The following names for membership were handed in: L. J. Fuller, J. D. Copeland, Alexander MacQuarrie, M. R. Morrow and Hector McInnes.

On motion these gentlemen were declared duly elected.

A Provincial Museum Building Wanted.

A letter from Mr. A. H. McKay was read asking the co-operation of the Society in the relation to the erection of a building designed to provide accommodation for the Victoria School of Art and Design, the Provincial Museum, the Akins library and for meetings of the Institute of Natural Science, the Mining Society and for other purposes.

The President expressed the opinion that the Society shoud lend its countenance to such a movement.

Mr. Gue suggested that it be left to the Secretary to secure the co-operation of such members of the Society as were available when the matter came up.

It was therefore resolved that the Secretary of the Society be a committee with such members as he might associate with him to assist in carrying out the views expressed in the letter of Mr. A. H. McKay.

Effect of a Lightning Discharge at the Scott Pit.

Continuing the Discussion of Mr. Chas. Fergie's Paper, read at the last meeting, Mr. J. G. Rutherford, Stellarton, wrote:—

"In 1835, before a Select Committee of the House of Commons on Accidents in Mines, George Stephenson, of locomotive and safety lamp fame, while admitting that the electric spark artificially produced would explode a mixture of fire-damp and air of a proper degree of inflammability* doubted the possihility of lightning causing an explosion of gas underground, and added 'I have never known or heard of an instance of a mine being fired by lightning.'"

Mr. John Buddle, probably the most practical mining engineer of his day, who was examined by the same committee a week later, in reply to the question, "In addition to the other contingencies, you have expressed a general opinion that those accidents may result from the sudden discharge of electricity produced from natural causes?" said "They may, but that is generally visible. I have never known an explosion from lightning except when it ignited the gas at the top of the pit." In support of his opinion he instanced the Lawson Main Pit, 70 fathoms deep, and not particularly fiery. The ventilation having been deranged from some cause the workings were filled with gas and as he expressed it, "the shaft itself became a gas-pipe and was then discharging what was generated below. This discharge was ascending in a current from the mouth of the pit, when the thunderstorm came on; a flash of lightning ignited the gas and a very heavy explosion immediately ensued." He stated that he had no connection with the colliery, but happened to be near the pit when the explosion occurred, and what is of further interest, he said "I went to see the havoc that had been made at the Lawson main pit, and had been there a short time, with a great number of other people, when another explosion, a most furious one, took place, when I was within 18 feet of the top of the shaft." This explosion occurred about an hour and a half after the first. He also informed the committee that his father had seen lightning descend the pumps in an engine-shaft, and while doing no more harm than alarming an engine-wright in the shaft by its "rattle," spent itself in the water in the sump below. Buddle's opinion was that had the pit bottom been foul an explosion would have immediately taken place.

At Tanfield Moor Colliery†, in the County of Durham, on July 12th, 1880, a flash of lightning passed down the working shaft, 216 feet deep, struck the flat sheets and then divided and passed through the workings, where over a distance of 70 chains it was seen by several men at various points. A committee of the Institute carefully investigated the matter and was satisfied from the evidence taken that the report was correct. No damage resulted on this occasion. There were two columns of steam pipes in the shaft, the exhaust extending 25 feet above the mouth. A heavy peal of thunder was heard underground simultaneously with the lightning. The characteristics of the discharge as observed were a flickering, unsteady light on the rails, accompanied by a noise resembling the explosion of gun-caps.

In the course of a long discussion which followed, Mr. D. P. Morrison mentioned a similar case occurring at Acomb, Hexham, at a pit that had been closed for two years. The wire-rope guides and ropes had been left in the shaft when abandoned, as well as the cages and the mouth of the shaft railed off, and it was impossible for anyone to be below, on the Sunday afternoon when in the midst of a thunderstorm and simultaneously with a flash of lightning, the pit blew up and the cages, ropes, etc., were thrown to the surface.

Mr. Henry White described a case of lightning descending the shaft of the West Thornley colliery on December 11th, 1883,‡ where on two previous occasions a similar electrical discharge had been observed. This colliery was 1000 feet above sea level and was sheltered on one side by a hill 50 feet high. The shaft was 25 fathoms deep, had steel ropes and cages, iron rail guides, iron buntons, four rapper-wires and three columns of steam pipes. According to the evidence of those employed at the shaft bottom, the lightning appeared to have descended by a rapper wire and then glanced to an uncovered portion of a steam pipe. There was a brilliant light and "a noise like that of the firing of a gun." The winding engine man saw the lightning strike the pulleys and the colliery chimney was struck and much damaged at the same time, but there was no damage done underground.

On the two previous occasions when the pit had been similarly visited, slight shocks were sustained, in one case by a banksman who had his hand on the cage's neck, and in the other by the underground engineman who had hold of the throttle valve handle and who also saw the lightning. It was supposed in both cases to have struck the rope and passing through the steel cage continued its way by the iron guides to the bottom and thence along the rails where on the first occasion it was seen on the rails 80 yards from the shaft.

On October 21st, 1886,* the same colliery was again struck despite the fact of a lightning conductor having been placed on the chimney which was only 68 feet away from the pulleys and 25 feet higher. On the day of the discharge a severe thunderstorm with much rain prevailed and the lightning went down the pit twice in five minutes. An onsetter close to the cage said the lightning appeared to come down the rope; another further away but within 18 inches of the steam pipe, saw the light and received a slight shock in his elbow and the hauling engineman, 40 yards from the shaft, stated that his engine house was lighted up and he heard a sharp report which led him to suppose that some part of his machinery had broken. While examining his engine he saw a second flash. Two lads attending a landing 660 yards from the shaft saw the place lighted up and heard a fizzing sound which was repeated five minutes afterwards.

Discussion.

MR. R. H. BROWN—Referring to the paper, said that at the time of the explosion the pit was full of gas which was issuing from the mouth of the pit. Half an hour afterwards a second explosion took place. The probability was that the first explosion did not ignite more than half of the gas in the pit, and, when a further supply of fresh air entered, the fire caused hy the first explosion ignited the remainder of the gas. The gas could not explode without a sufficient admixture of oxygen.

MR. CHARLES ARCHIBALD asked whether the explosion occurred at a time when there was a low temperature.

THE PRESIDENT—No. The pit was ventilated by means of a fan. This was not in operation and had the effect of closing the pit.

MR. CHARLES ARCHIBALD said that the air must have got in some way. The probability was that the explosion occurred at a time when the conditions were most favorable.

MR. R. H. BROWN said that the lightning, in entering, followed the rail. In the English instances it had followed the cage.

MR. W. BLAKEMORE said that he had never heard of a similar case in South Wales. At all events there was no case on record in recent years. He asked whether he understood correctly that the mine was closed and that there was an accumulation of gas.

THE PRESIDENT said that the mine was closed in consequence of the fan, which was not in operation, but there must have been some slight current of air. The pit was temporarily closed for the want of water.

MR. W. BLAKEMORE said that if there was no circulation of air the gas would not explode. He had never met with such a case either in South Wales or in the Midlands of England.

Government Aid to Mining.

THE PRESIDENT suggested that the paper by Mr. J. E. Hardman on the subject of "Government Aid to Mining," be read before the Mines Committee of the House of Assembly. He thought it would be well if a resolution was moved to that effect. The Society should ask permission to appear before the Committee of the House and lay their views before it.

MR. G. W. STUART moved that the Council of the Society send a committee before the Committee of the House of Assembly on Mines and Minerals.

MR. J. H. AUSTEN seconded the motion, which was agreed to.

THE PRESIDFNT said it would be well for members of the Society who had any suggestions to make to do so now, so that they might be embodied in a letter to the Provincial Secretary.

The Duty on Mining Machinery—Free Explosives Wanted.

MR. B. T. A. BELL—In view of the visit of the Right Hon. Sir John Thompson and Sir Charles H. Tupper to Halifax this week, would it not be advisable that a deputation from the Society obtain an interview and explain the necessity for some clearer interpretation of the law relating to the imports of free mining machinery?

MR. CHARLES ARCHIBALD—This would be a good opportunity to bring the matter before the Government.

MR. B. T. A. BELL—I may add that the General Mining Association of Quebec has been notified by the Hon. the Comptroller of Customs that the resolution of that body asking for an extension of the language of the Act will receive consideration by the Government when it revises the Tariff.

MR. G. W. STUART did not think that any of the gold mining men had difficulty in getting in free of duty gold mining machinery which could not be manufactured in the country. At least he knew of no instance where duty had been paid on machinery which could not be manufactured in the country. But so far as gold miners were concerned, there was a subject of even greater

*NOTE.—This idea is now known to be erroneous.

†Transactions North of England Inst. of M. and M. E. Vol. xxx, Part I, p. 31.

‡ Trans. North of England Inst. of M. and M.E. Vol. xxxiii., Part iii. p. 81.

*Trans. North of England Inst. of M. and M.E. Vol. xxxvi, Part 1, p. 47.

importance than that of the duty on machinery. He referred to the duty on explosives. The bill for explosives, year in and year out, was far in excess of that of machinery. There was another difficulty. There was not a railway in the United States that objected to carry dynamite, while the I.C.R. would not carry it under any consideration and the manufacturers suffered as well as the consumers in consequence. He thought that any committee appointed to interview members of the Government should discuss these matters as well.

MR. BELL—With the general tenor of the Customs Law there was no great objection. Unfortunately, however, members of this Society who had to import such specialties as coal-washing and briquette-making machinery had been given a ruling that according to the language of the law plants of these and similar kinds were manufacturing and not mining plants. An altogether erroneous construction. The government had promised to consider the matter and a quiet talk with the Ministers explaining the situation would doubtless be of benefit to the stand the Society had already taken in the matter.

MR. STUART asked whether Mr. Bell objected to having the question of explosives dealt with at the same time.

MR. BELL said that he had not considered the question.

MR. JOSEPH AUSTEN said that his firm had been in communication with the Comptroller of Customs in relation to the duty on wrought iron pipe of over two inches in diameter. This was mining machinery in every sense of the word as no pump was complete without it, but the Comptroller of Customs said that such pipe, above two inches in diameter, could not come in under the head of "mining machinery." His firm had imported a quantity of six inch pipe for the New Glasgow Coal, Iron and Railway Co., and different mines imported large quantities of pipe ranging in diameter from three and four to six inches. This was a very important point.

MR. DAVID MCKEEN, M.P., thought Mr. Bell's idea a good one. It was very much in a line with the contentions recently made by the Dominion Coal Co., Limited. He would be more than pleased if a committee of the Society could have an interview with the Ministers and have the matter fairly represented to them. Instances continually arose where officials maintained that machinery of a certain description was not mining machinery. The trouble was that they did not understand it and he thought it would be well to have a schedule of such machinery as might be required made out and presented to the Ministers. In respect to wrought iron pipe he was rather of the opinion six inch wrought iron pipe was admitted free of duty. The Dominion Coal Company imported some the other day and he did not think that they were required to pay duty after representing the matter. In view of the unsettled state of the tariff question he thought it might be premature to make a demand for concessions. There might be some very material changes made with respect to machinery.

MR. BELL said the question was merely with respect to the interpretation of the present Act.

MR. HAYWARD said that to gold miners the question of explosives was a very serious one, and if the Ministers were to be waited upon he would like this question to be brought up.

MR. HARDMAN thought it would be better simply to appoint a committee and instruct them on various points rather than pass a resolution defining what the duties of the committee were to be.

MR. MCKEEN said there could be no use in giving any detailed instructions to the committee. It could only be a *pro forma* matter in any case. A committee would be appointed and certain contentions would be brought to the notice of the Ministers, and, for the present, that would be the end of it. If one member of the committee who favored a change in respect to explosives was appointed and another who favored a change in respect to the duty on mining machinery the views of all parties could be brought out.

MR. STUART—Why do you object, Mr. Bell, to adding the question of explosives to your resolution?

MR. BELL—Mainly because the Society has unanimously put itself on record respecting the mining machinery question, while the subject of explosives has not been before the Society until to-day. In the order of business, he thought Mr. Stuart should put his resolution separately and have it discussed by itself. Personally he knew nothing about the explosive question further than he was strongly of opinion that the home manufacturer should be encouraged. He would move the following:

(*a*) "Resolved, that a deputation from the Society obtain an interview with the Right Hon. Sir John Thompson during his present visit to the Province respecting a more liberal interpretation of the law relating to the importation of mining machinery not manufactured in Canada."

(*b*) "Resolved, that the same deputation urge the necessity of the carriage of explosives on Government lines of railway."

The resolutions were respectively seconded by Mr. John Hardman and Mr. Frederick Taylor.

MR. STUART moved, seconded by Mr. Hayward that the discussion be adjourned and be resumed at 2.30 p.m.

THE PRESIDENT put this resolution which was declared lost.

MR. HAYWARD then moved in amendment to Mr. Bell's resolution, seconded by Mr. Archibald, "that the committee be also instructed to urge the reduction of the duty on explosives imported into Canada."

MR. STUART said that the cost of explosives here was a hundred per cent. more than it was in the United States, and he failed to see why people operating mines should be placed under such a burden.

MR. HARDMAN said that the effect of a reduction of the duty on explosives would be that dynamite would be imported and would not be made in this country as it could be. The question in respect to machinery had been before the Society for three years and had been before the Quebec Association for the same length of time while the question as to explosives had never been brought up before. There was no connection between the two questions and no reason why they should be embodied in the same resolution.

MR. BELL said that dynamite and other explosives were made in the country and he was in favor of making them as cheaply as possible.

MR. HAYWARD said he did not see that any further discussion as to the duty on explosives was necessary. He had not heard any valid reason given for refusing to incorporate that matter in the resolution.

MR. BELL said he would agree to the two clauses of his resolution being consolidated, but he could not consent to adding free explosives.

It being lunch time the Chairman put the resolution which was carried, together with Mr. Hayward's amendment.

AFTERNOON SESSION.

Amendments to the Mines Act.

The members assembled in the rooms at 3.30 p.m.

The Society proceeded to the discussion of amendments to be submitted to the Committee of Mines and Minerals of the House of Assembly in relation to coal and gold mines.

MR. G. W. STUART thought that deputies should be appointed for the different gold mining districts. Many outlying districts suffered from being so far from the the head office.

MR. J. C. MCDONALD contended that deputies should be appointed for the various districts to place people living in the districts in as good a position as people living in Halifax. People in the city took up areas and held them for sale only.

MR. J. E. HARDMAN thought that the best policy would be to abolish the present deputies. He thought the Government would probably do that more readily than they would appoint others.

MR. STUART proposed the amendment of chapter 122 of the Revised Statutes (4th series) "of the partition of lands" so as to make it applicable to gold areas held by two or more persons who could not agree as to the working of the areas. He read a draft Act which had been prepared with this object; also an Act to amend the Act to consolidate the Acts relating to mines, making areas held by two or more persons subject to the Act in respect to the partition of lands.

MR. HARDMAN thought that the remedy proposed would meet the case.

MR. FREDERICK TAYLOR said that the chapter of the Revised Statutes referred to, at present only applied to real estate. The amendment making the chapter applicable to mining areas, he though, was exactly what was wanted.

MR. GEORGE STUART said that there were many good properties lying idle because the parties owning them could not agree either to work or to sell.

MR. C. E. WILLIS asked whether if a property was sold under the Act one of the parties could not buy it in.

MR. STUART—Certainly.

MR. A. A. HAYWARD thought that if one of the parties was a man of means, and the other a poor man, the enforced sale will give the former a strong lever against the latter.

MR. HARDMAN said the parties would no doubt try to come to an amicable arrangement rather than allow the property to be sold.

MR. B. C. WILSON said that there was a great unfairness in the law as it stood at present. He thought the remedy proposed would be satisfactory. He had had some experience of the working of the law in connection with real estate.

MR. J. C. MCDONALD asked whether there was any provision for sale in any other way than by public auction. Such a sale was often a poor criterion of value.

MR. B. C. WILSON it would be the duty of the arbitrators to make a fair division if they could, as in the case of real estate. If the parties could not agree among themselves, and a fair division could not be made, there was no alternative but to sell.

MR. J. E. HARDMAN said that the effect of the amendment proposed, practically, was to make mining areas real estate.

MR. B. C. WILSON said that if the chapter was made applicable the properties would be divided with the minimum of injustice.

MR. A. A. HAYWARD thought that present ownerships should not be disturbed.

MR. G. W. STUART said that many properties which should be productive were now lying idle.

MR. C. E. WILLIS did not think there was any advantage on one side more than the other.

MR. JOS. H. AUSTEN said it would be a good argument for the poor man to address to the arbitrators that his co-owner was trying to freeze him out.

MR. JOHN HARDMAN said that the fact that such an Act was found to be necessary in the case of real estate showed its necessity in the case of mining property.

MR. JOS. H. AUSTEN thought that while there might be an occasional injustice the remedy proposed would be of great assistance.

On motion of Mr. Stuart, seconded by Mr. Taylor, it was resolved that the amendment proposed be brought to the notice of the Committee of the House of Assembly on Mines and Minerals.

MR. JOHN HARDMAN moved that the Council be instructed to embody in a communication to the Government the views presented at this and past meetings relative to amendments to chapters seven and eight of the Revised Stututes. (The Mines and Minerals Act, and the Mines Regulation Act.)

MR. B. C. WILSON seconded the motion, which was passed.

The meeting then adjourned until 8 p.m.

EVENING SESSION.

At the evening session which, was held in the St. Julian Dining Room, Halifax Hotel, there was a large attendance, probably the best since the Society was organized, the President in the chair. The meeting proceeded to consider the following paper:

Iron Making in Nova Scotia Early in the Century.

By MR. H. S. POOLE, Stellarton.

The successful establishment of Iron Works at Ferrona, in Pictou County, according to the most modern practice, makes all the more interesting to record an early trial, made over sixty years ago, to produce pig iron from ores of that county.

When the General Mining Association obtained the mineral concessions granted the Duke of York, the coal pits at the Albion Mines, now called Stellarton, were opened on a greatly extended scale. A large brick building was put up in 1828 for foundry, machine shop and milling purposes. Power was obtained from a condensing engine, which is still on the ground.

At the same time the sum of £1,000 was put aside for the purpose of experimenting in iron making. A furnace was erected on the north side of the foundry in front of an archway, now bricked up, that led into the casting house. No plan of the furnace has been found. It was probably about forty feet high and eight feet in diameter at the boshes. It was lined with special brick a foot thick, made key shape to suit the circle, and backed with a course of stretchers, between which and the casing there was a space of four inches filled with sand. The casing was eighteen or twenty inches thick, built with a batter and hooped. The hearth was built of special brick set on end. This furnace was not pulled down until 1855. An inclined way, laid with iron rails, led to the top of the furnace for charging purposes.

The season of 1829 was spent in experimenting with the several ores of the district. A small quantity of limonite was obtained from the Fraser-Saddler property at Bridgeville, but the bulk of the ore tried was red hæmatite brought down McLellan's brook from the locality now known as Iron Mines Post Office, where it is naturally exposed, and was easily got by open quarrying. The clay ironstone nodules, which occur in the coal were also carted down from the pits to the foundry, and roasted in open heaps. In the search for iron ore Coal Brook was well explored and a surface trench followed up the brook for 800 feet. This trench was timbered, and when opened a few years ago, much of the timber was found to be sound.

The blast for the furnace was got from the foundry engine erected in 1828, and which continued in use until 1871, when new machine shops were put up. The engine was condensing and the pressure of steam carried was about five pounds, regulated by a tank of water placed at the necessary height. When in the course of time leaks in the boiler occurred, temporary repairs were effected by a layer of horse manure covered by a plate of iron.

Besides the plant referred to preparations were made for operating on an extended scale, and a blowing engine was imported. The air cylinder of this engine remained lying on the river's bank, where it had been landed half a century before, until 1884, when it was broken up. But the steam cylinder and beam were utilized in Gordon's pumping engine at the bye pit of the second lift of workings, afterwards known as the "Crushed Mines," and the blast pipes found service as a conduit for the first fill on the South Pictou or Albion Railway below New Glasgow, where doubtless they may still be found.

It is said that in all some 50 tons of metal were made, but of a quality that was useless for foundry purposes; it was hard white iron, pieces of which still lie about the yard. Of what was made part was used as ballast for the slip at Shipyard Point, on the East River. Weights about the colliery were made of it. The "baby" on the rope used in the Foord pumping pit is still on hand, and current report confirms Professor How's statement that stampers of a quartz mill at Waverley, made of it, had been pronounced to be ten times more durable than Belgian iron.

Mr. Joseph D. Fraser, chemist at the Ferrona Iron Works, who has interested himself in these early operations, interviewed James McDonald, now 85 years old, one of the prospectors for ore, and his story is:—That the Rev. Dr. McGregor, on whose farm the coal of the Albion Mines was found in 1818, accompanied Mr. Richard Smith, the manager at the Albion Mines, in 1828 up McLellan's Brook, and obtained samples of hæmatite ore which were sent home to be analysed. The report received was favorable and accompanied by a snuff-box,

pen-knife and razor, made from the sample. Mr. McDonald was then employed getting out ore at Blanchard, where it was found solid at a depth of 13 feet, and was blasted out for transportation to the Albion Mines.

Haliburton in his history, page 428, speaks of an experiment having been "made at the Albion works to reduce some of the clay ironstone, mentioned in his mineral section, viz.:—No. 4, 144, 156 and 158, into iron in a crude state, by means of a small cupola erected especially for melting pig iron for foundry purposes only, and which is not at all calculated for smelting ore. The cakes having been prepared in the ordinary way, and the ironstone calcined, the proper proportions of each were gradually introduced into the cupola, to which was also added a little limestone for a flux. In a few hours this small melting pot (for so it may be termed) produced a result of 35 per cent. of metal, which was so lively and fluid in its nature, that the workmen employed cast from it some delicate ornaments, and the remainder was formed into pig iron of No. 1 quality, presenting a fine smooth face, and yielding freely to the file and drills."

This experiment can hardly refer to the special furnace elsewhere mentioned, but it may have led to the trials in the larger furnace which local tradition says were protracted and met with many difficulties. On one occasion it is reported the metal in the bottom cooled and had to be cut out by hammer and chisel. Certain it is the furnace first used was rebuilt.

Mr. Fraser also furnishes an analysis he made of the metal cast in 1829 at the Albion Mines:

Silicon	0 409
Manganese	0·504
Sulphur	1·238
Phosphorus	0·788
Combined Carbon	1·295
Graphite Carbon	0·668
Total Carbon	1·963
Metalic Iron	95·098
	100·000

Of the ore got from McDonald's,* at Blanchard, an analysis was published in the Mines Report, page 81, for 1874, as follows:

Oxides of Iron	60·71
" " Manganese	0·18
Silica	29 97
Sulphur	0·09
Phosphoric Acid	0·63
Yielding Metallic Iron	42·50

An earlier attempt at iron making than this in Pictou County, Haliburton, page 163, tells us was made at Nictau many years before he wrote, in 1828-9. He further tells us that in 1825 the Annapolis Iron Mining Company obtained a charter and bought iron lands in Annapolis County, at Nictau and other spots; finally selecting the right bank of Moose River, eight miles from Annapolis for the site of their furnace and erections. Dr. Gesner, in his Industrial Resources of Nova Scotia, 1849, describes the works, page 255, but speaks of what they were, how that "the smelting, casting and manufacture of iron commenced under the most favourable auspices, and both the ore and the iron produced from it proved to be unexceptionable," but for reasons he enumerates "the trip hammers ceased to move, and the pretty village of Moose River was deserted by all its inhabitants."

Dr. How, in his Mineralogy of Nova Scotia, 1869, page 100, quotes from Knight's Prize Essay on the Resources of the Province, that smelting operations were resumed at Clements after a stoppage of thirty-three years, and on the authority of the Bridgetown Register that in 1862, five tons of iron a day were being turned out. In a year or so the works were again closed and so remained until 1874, when a partial attempt to re-open was made.

Messrs. Jackson and Alger, in their Mineralogy and Geology of Nova Scotia, 1832, describe what they saw of the Province in 1827. They mention that "the bed of ore at Nictau has been opened to the depth of eight or ten feet, and some hundred tons of the ore have been removed to the smelting furnace, situate on the southern shore of Annapolis Basin." Again they say, page 89, when referring to the ores of the South Mountain, between Nictau and Clements, "Should the spirit of competition among iron manufacturers in Nova Scotia ever equal that which characterizes some quarters of the United States, it is believed that no part of this range will long remain unexplored or fail to produce abundantly that article, on which depends so many other arts and manufactures." A spirit of competition, as is well known, has arisen in the Province, but it still leaves this district of country practically untouched. In this section of country the ores are all highly metamorphosed by proximity to masses of granite, but eastward of Nictau river, on the extension of the same range, as distance from them is attained, the effect decreases. At Wheelocks, only some of the bands of shell ore are magnetic, while at Torbrook, still farther away, the ore is altogether red hæmatite. Of the deposits at the latter place and the district in general, we have an interesting paper by Mr. R. G. E. Leckie, published in Part 2 of Volume 1. of our Transactions. Messrs. Jackson and Alger also refer, page 96, to the closing of the establishment at Clements.

But the connection of both these authorities with the early iron making in Nova Scotia is more clearly explained in a letter of October, 1855, by the former to Mr. Charles D. Archibald, respecting the Victoria Mines at Nictau. In the letter in question written from the State Assayer's office in Boston, Dr. Jackson says:—"The ores from Nictau mines were smelted under my observation at Clements, N.S. in 1827, and I had then an opportunity of seeing the excellent iron which they produced, both pig iron for foundry purposes and bar iron. Mr. Cyrus Alger, the distinguished iron founder, began the enterprise of working the iron ores of Nova Scotia at the Annapolis Iron Works, and met with all the success that could have been expected in the business though the works suspended operations ultimately, owing to political causes." He then speaks of the advantages possessed by Nictau for making charcoal iron, of the inexhaustible supply of iron ores at that locality and the quality of the ore. Concerning the latter he says:—"It will be seen by my analysis, that there is between 5 and 6 per cent. of lime in the ore, nearly enough to form a fusible slag with the silica and allumina, with a little oxide of iron. This ore is certainly the most remarkable of any known in America, both for its abundance and its singular constitution. It is one of the very best known in the country for the production of the finest iron, both foundry and forge pig."

Dr. Jackson was accompanied on his visit in September, 1855, by Mr. John L. Hayes, of Washington, who also made a report on the property. Among other things he said: "Fortunately the excellent qualities of this ore and the facility with which it is worked in the blast furnace have been practically demonstrated. Bar iron was made from this ore in a small catalan forge some fifty years since, and several hundred tons of it were smelted in the blast furnace which was formerly in operation upon Moose River. * * * Having been personally engaged in the manufacture of charcoal iron, and having visited nearly all the charcoal iron establishments east of the Alleghany Mountains, I know no locality in the United States which presents advantages equal to those of Nictau. * * * I have conversed with Mr. Alger, who erected the furnace at Moose river, and he confirmed the statements I have made that the Nictau ore was worked in the furnace with more facility than any other ore which could be found."

Mr. R. F. Mushet is also made to speak in the same unqualified terms of the excellence of the iron made and the "unrivalled" character of the ore for iron making. With such recommendations the Acadian Iron Mining Association succeeded in raising in London the necessary capital to float the Acadian Iron Company, which built works at Nictau, and according to Professor How, exported in 1858 some 744 tons of iron, and in 1859 some 1,125 tons.

Dr. How also describes the shell ore with distinct polarity, a most unusual feature, and he adds, with reference to the phosphorus in the ore which the Rev. Dr. Robertson informed him "is supposed to depress the marketable value of the iron": "I have learned from another source that the ore contains phosphorus and the quality is said to be injuriously large." And yet the analyses of Dr. Jackson do not show either phosphorus, sulphur or titanium.*

Dr. Harrington gives notes on the iron ores of Canada in the Geological Report of Progress for 1773-4:

One of the furnaces built at Nictau was 35 feet high, 9 feet in diameter at the boshes, and 4½ at the throat. The second furnace was of the same diameter but 3 feet higher.

At Clementsport the furnace that was repaired in 1874 was "35 feet high, 4 feet in diameter at the hearth, 9½ feet at the boshes, and 7 feet at the throat. It had three tuyers, and the blast which is hot and has an average pressure of 1¾ to 2 lbs. to the square inch, is produced by water power; and the wheel, a breast wheel, is 30 feet in diameter. The blowing cylinders, three, are of cast iron, 4 feet in diameter and 5 feet stroke. The blast is heated by burning the waste gases from the furnace in a hot blast oven containing 17 siphon pipes, through which the air is made to pass. The oven is on a level with top of the furnace, and is of brick, bound with iron. The ore, called 'grey magnetic," is from the Potter mine and yields 45 per cent. of pig iron, but of poor quality, unless an equal weight of Bloomfield bog iron ore, which carries 26 per cent. of metal, is used, when the quality is improved. The fuel is charcoal, 130 (Winchester) bushels making one ton of pig. The limestone used as flux is from St. John, N.B."

The report of the Department of Mines for 1873 by the writer, states that in that year 630 tons of ore were smelted, and the metal produced only 180 tons; part of the ore having been taken from the Miller mine. Analyses of the Nictau ores were given in the Report for 1874, page 81, and for 1875, page 61, showing sulphur from ·05 to ·09, and phosphorus from ·16 to ·79 per cent.

DISCUSSION.

Mr. R. G. E. LECKIE said that he hoped to be able in a short time to prepare some notes to add to Mr. Poole's paper.

Mr. H. S. POOLE said that Mr. Fletcher of the Geological Survey was present. Mr. Fletcher, if not already familiar with the country referred to, would work over it shortly and the Society would be glad to hear from him.

Mr. HUGH FLETCHER said that he had visited the country some few years ago, and had taken some notes, but Mr. Leckie, no doubt, was much more familiar with it than he could be, after such a short inspection.

Mr. B. T. A. BELL moved a vote of thanks to the President for his valuable contribution to the literature of the Society. The paper, together with that read at the June meeting by the Rev. Dr. Patterson, on the Early History of Coal Mining in Pictou County would be exceedingly valuable for reference.

Mr. JOHN HARDMAN took pleasure in expressing his concurrence in Mr. Bell's remarks and in conveying to the President the assurance that the paper read by him was one of the most valuable contributed to the Society.

Gold Chlorination—A Description of the Newbury Vautin Process.

By F. H. Mason, F.C.S., Truro.

I will first draw your attention to the chlorinator used by the Newbury Vautin Co., of which I have made a rough sketch and colored it equally roughly, but it will enable you more plainly to see of what the different parts are constructed,

The figure represents a front elevation of the chlorinator with the cover in section. The main body of the chlorinator is made of wood bound together by bands of wrought iron, and is swung on trunnions which are supported on V shaped castings; both the covers are detachable and are fastened on by bolts and nuts, the joint is made of asbestos cloth, soaked in melted paraffin or sometimes of rubber; the whole of the inside is coated with paint, the body of which is made of ferric oxide, which has been found to be capable of resisting the action of chlorine, but the continual abrasion of the ore against the sides of the cylinder, renders it necessary to renew this coat of paint fairly often, and this I consider one of the weakest points in the construction of the machine.

In the centre of one of the covers is a tap made generally of glass lined iron tubing, with a stoneware or vulcanite cock, in some cases the whole tap is made of stoneware.

The filter bed, a section of which you see, is made of wood, with grooves turned in it and holes are made in these grooves right through to the other side, the whole of the wood is coated with the paint already mentioned; a piece of stout closely woven canvas is stretched across this and forms the filter. The crests of the corrugations (if I may use the expression) support the canvas and enable it to carry the weight of the ore, while the auriferous solution percolates through the canvas into the troughs from whence it runs away down the holes.

Having described the machine I will now by the aid of this skeleton section through a chlorination works, metaphorically speaking take you over it and point out the methods of conducting the processes as we go along. The concentrates are brought into the sampling room, where they are thoroughly mixed and laid out into a square of uniform thickness, string is stretched across this square from pegs, placed around the sides at equal distances from each other, thus dividing it into a series of little squares, from each of which a box capable of holding two pounds is filled and placed on one side to form the sample; this if properly carried out should form a fair sample, which is sent to the laboratory where a pot assay is made of it, it is then roasted in a small roaster placed outside the laboratory, the loss of weight through roasting noted, and an assay of the roasted concentrates made, the increase in the percentoge of gold in this second assay should of course be directly proportional to the loss in weight through roasting. From the roasted ore quantities of about three pounds are taken and placed in stoneware bottles made for the purpose, it is then made into a thick mud with water, and chloride of lime, and sulphuric acid added, the proportions of these last two substances varying in each bottle, (thus supposing four experiments were made one might contain ½% of chloride of lime another 1% and the others 1½% and 2% respectively) these are placed in a cylindrical box connected by a belt to the main shafting and rotated at from 10 to 12 revolutions per minute for a given length of time. The contents are then turned out and thoroughly leached with water and the tailings assayed; the best of these experiments, viz., the one taking out the gold with the least chloride of lime is repeated in a miniature chlorinator constructed exactly similar to the larger ones and capable of holding about 100 lbs. of ore; if this result is the same as in the smaller experiment, then the quantities of chloride of lime used in this experiment will also be used in the actual chlorination. The ore is now taken from the sampling room, placed in trolleys and run up the lift to an elevated trolley line running along the centre of the roasting room (I could not very well show it in the sketch) and is shot through a chute into the roasting furnaces of which there are four, two on each side; when roasted perfectly sweet it is removed, placed in trolleys sent up the lift to the top floor, and from there shot through hoppers into the chlorinators of which there are ten, five on either side, each of which is capable of holding from one and a half, to two tons of ore; from the bottom of the hoppers there is a canvas pipe to let the ore right into the chlorinator and prevent dust getting about the building.

After the first trolley of ore has been shot into the chlorinator, the chloride of lime is put in, then the remainder of the ore and sufficient water to make the

*Fletcher's Geological Report, 1892, p. 182, P. Patterson's History of Pictou, p. 425.

*As these notes only relate to iron making early in the century, reference to the operations at Londonderry, in Colchester County, begun in 1849, is purposely omitted.

whole into a thick mud; the cover is now put on and a turn or two given to the chlorinator to thoroughly mix the contents, then the sulphuric acid is added and the cover fastened firmly on, air is pumped in through the cock until a pressure of 60 lbs is obtained; the chlorinator is then set revolving at from 10 to 12 turns per minute.

When the chlorination is completed the required time being known from the results of the small experiments, the chlorinator is stopped with the cock uppermost, and any excess of chlorine is allowed to escape outside the building through a rubber pipe attached to the cock; the chlorinator is then turned over, the cover taken off and replaced by the filter bed, the machine is once more turned over, the lower cock opened and water forced through the upper cock, if difficulty is found in filtering a suction pump having an intermittent action is employed under the filter bed, by which arrangement it has been found that the ore is less liable to clog. The leaching is continued so long as the solution contains any gold. Any silver there may have been in the concentrates will have been converted into chloride, and if there is sufficient to pay for extraction, either a saturated solution of brine or a solution of hyposulphate of soda is put into the chlorinator, and it is set revolving again. The silver solution is afterwards leached out and the silver precipitated on metallic copper, which in its turn is again precipitated on scrap iron. When the leaching is finished the top cover is removed and the chlorinator turned over the ore falling into a hopper below, and is washed away down a chute to the ouside of the building where it is either taken away by trolleys waiting to receive it or run directly into a stream. Now comes the recovery of the gold from the auriferous solution, and here I want to bring to your notice a precipitant which is not I believe generally known. The gold chloride is passed up through a stoneware or glass pipe containing powdered grey sulphide of copper and directly it comes in contact with this substance it is instantly precipitated, mainly as metallic gold together with sulphur, copper chloride going into solution; this copper chloride flows out of a small exit at the top of the pipe, and is run over scrap iron on which it is precipitated as cement copper, this is afterwards dried and fused with sulphur, which once more converts it into sulphide of copper. When the copper sulphide has become sufficiently charged with gold to necessitate a "clean up" it is simply melted in a crucible and poured into a mould. The gold by virtue of its higher specific gravity sinks to the bottom, while the copper sulphide forms a regulus above it, from which it is easily detached. For some reason which I hoped to have been able to explain to you but have not had the time to devote to it, the gold always carries a certain amount of copper down with it, but in a chlorination works it is a simple matter, to refine this by the Miller process with which you are probably all acquainted. I think the probable reason for this is that the leachings always contain a certain amount of free chlorine. This being a powerful oxidizing agent converts some of the copper sulphide into sulphate, and these two react on each other in the crucible with the formation of metallic copper and sulphurous anhydride.

$$Cu\,SO_4 + Cu\,S = Cu_2 + 2\,SO_2.$$

The sulphide of copper from which the button is detached always retains a small quantity of gold, but as this retention is not accumulative it is a matter of small moment because it is ground up and used once again as a precipitant, so no gold is lost. To chlorinate roasted sulphurets it requires on an average from 1 to 3 per cent. of a good chloride of lime (having over 30% of available chlorine) and about double that amount of sulphuric acid, that known in the trade as B. O. V. or brown oil of vitrol being used.

The duration of the process lasts from two to six hours and depends of course mainly on the coarseness of the gold particles and on the quantity of gold present; the addition of pressure in the chlorinator considerably reduces the time necessary to complete the process.

I hoped to have been able to give you the results of experiments on several sets of Nova Scotian concentrates but owing to circumstances over which I had no control, I am unable to give you the results of experiments on more than one set of concentrates; two or three gentlemen promised to let me have concentrates from their mines, but owing no doubt to pressure of work failed to fulfil their promises, however our worthy Vice-president was kind enough to let me have a sample of the concentrates he is saving at Oldham and the result of my work on them will I think clearly show the advantage of saving such concentrates. There are I believe several mines in Nova Scotia to-day, which are letting valuable sulphurets go merrily away with their tailings and to them, or rather to their owners, the old adage of "what the eye does not see the heart does not grieve after" particularly applies.

The results of my experiments on the tailings from the mines of Messrs. Hardman and Taylor at Oldham, I will give you in a tabulated form:

Pot Assay.	Loss per cent. on Roasting.	Assay after Roasting.	Tailings Assay after 1½% Chloride of Lime 5 hours.	Tailings Assay after 2% Chloride of Lime 5 hours.	Tailings Assay after 2% Chloride of Lime 6 hours.
3 oz. 8 dwt. 14 grs.	32	4 oz. 19 dwt. 23 grs.	4 oz. 11 dwt. 11 grs.	6dwt. 12grs.	Trace.

The cost of roasting and chlorinating this ore would, I estimate, roughly range somewhere between $5 and $7 per ton which would leave a very handsome profit. The plant of which I have given you a skeleton sketch would be capable of chlorinating 30 tons of ore per day of 10 hours, but the number of roasters would have to be increased if only sulphurets were treated. The original cost as well as the running of the plant as you will readily see is not a very heavy one.

I am convinced that if the gold miners of Nova Scotia would combine and start a central plant, it would not only pay handsomely itself but would add considerably to the value of their mines.

In conclusion, I am afraid I have given you the opportunity of saying that this paper is like the road to heaven "paved with good intentions," but I hope at some future date, to add a rider to it, going into costs minutely, and clearing up one or two points I have left rather in a haze.

DISCUSSION.

MR. HARDMAN said he was sure that the people who were interested in gold mining were under great obligations to Mr. Mason for his paper. The suggestion contained in the last part of the paper that the mines should combine in the erection of a central plant was a good one. When the number of mines that there were in this province were considered, and it was remembered that there never yet had been a successful attempt made to treat the sulphurets, language failed him to say what the state of mind of the gold miner should be. Mr. Mason had demonstrated that the sulphurets obtained were of sufficient value to pay handsomely for treating them.

MR. C. E. WILLIS said that he had thought that a concentrating plant would be a good thing, but recently, in looking over the returns in the Mines Report, he was led to the belief that the thing was smaller, perhaps, than it had been thought. The mines of Nova Scotia were scattered over a large extent of country, and a good deal of the stuff to be concentrated would be of low grade, while the facilities for carrying it were not good and the question was whether it would pay, providing every ton was saved. It would be impossible to get all. About one-third might be taken off, which would reduce the quantity available to 1,000 tons. Would this pay?

MR. HARDMAN said that he would be glad to buy all that was offered. He did not think there was any doubt that if 1,000 tons could be obtained it would pay very well to treat it in a central plant.

MR. MASON said that the plant was not expensive.

Cast Iron Tubbing in the Shafts at Sydney Mines, C.B.

By MR. R. H. BROWN, Sydney Mines.

I had first intended to confine myself to a description of the Cast Iron Tubbing put into the shafts known as the Princess Pits of the Sydney Mines, the property of the General Mining Association of London; but it seems desirable also to give a short account of the sinking of those pits, as intimately connected with the subject of the tubbing.

There are two pits sunk to the coal, namely: The B pit or winding shaft, of 13 feet diameter and 682 feet in depth; and the C pit or pumping shaft, of 11 feet diameter and 709 feet deep to the bottom of the sump, 22 feet below the seam of coal; there is also a staple or auxiliary pumping pit, sunk to a depth of 389 feet from the surface. A drift from the bottom of the staple connects it with the C pit. In pumping, the water is raised from the sump in the C pit a height of 332 feet to the drift, whence it flows into the staple sump, and is pumped thence, a height of 346 feet, to the delivery drift, situated at 42 feet below the surface. The water runs through this delivery drift, a distance of 516 feet, to the shore of Sydney Harbour.

The sinking of these three shafts was commenced in the spring of 1867, and when in the year 1868 a depth of some 200 feet had been reached, a feeder of water was met with, which made it necessary to provide pumping power. A set of 8 inch pumps, worked by a small horizontal engine, was then erected, which coped successfully with the water for a time; but soon more water was encountered, so that sinking operations had to be again suspended until the main pumping engine should be imported and set up. Sinking was then recommenced and progressed until a heavy feeder of salt water was met with in the pumping shaft at a depth of 267 feet from the surface. This water came through fissures in the thick bed of sandstone direct from the sea; it was therefore found necessary to shut off the water by lining the shafts with cast iron tubbing.

A quantity of tubbing was then cast, and after 192 feet in depth of the pumping shaft, and 150 feet in depth of the staple, had been tubbed, and the upper feeders of water first met with had been thus shut off, a struggle was made to sink through the water-bearing strata, the extent of which in advance was unknown, Our pumping engine, of the Cornish type, with cylinder of 62 inches diameter by 9 feet stroke, had been erected; and now a sinking set of pumps of 20 inches diameter, with the necessary outfit of pumping spears, ground spears, ground ropes, sheaves and crabs, was fitted up. The sinking was then pushed on, and during many months we had as much as 650 gallons of water per minute to pump day and night, while the sinkers worked putting in their shots around the windbore or suction pipe; the water rising two inches in the shaft after a stroke of the pumps before another stroke could be taken. The buckets and clacks had always to be changed by drawing them up through the pumps, for the influx of water rising in the shaft at the rate of 13 inches per minute, gave no time for taking off bucket or clack doors for changing in the usual way.

At length the wet beds of sandstone and shale were passed through, and a bed of dry solid sandstone was reached at a depth of 323 feet down from the surface.

A wedging crib was bedded in this sandstone, and the shaft was tubbed up thence a distance of 92 feet to the bottom of the tubbing that had previously been put in.

When the pumping shaft and staple had been tubbed, they were sunk almost dry for the remainder of the depths, to completion. The sinking of the winding shaft was then resumed; the feeders of water met therein, being passed to the pumps in the C shaft by means of a bore-hole from the bottom of the former. The tubbing of this shaft was effected as soon as the wet strata had been sunk through and the balance of the sinking was completed dry to the coal.

The tubbing is cast in segments of 24 inches deep, except where closers of a less depth are required, and in length convenient for handling, and depending upon the circumference of the pit; thus, 9 segments complete the circle in the B, or winding shaft; 8 segments in the C, or pumping shaft; and 5 segments in the staple.

The tubbing is put in by lifts; a lift consists of a crib, and from 5 to 50 courses of tubbing built up thereon.

The situation of each crib depends upon a good hard stratum of rock being met with suitable for a crib bed.

This bed has to be dressed down with chisels with much care, and cut to a perfectly level and even surface.

When the crib, of 8 or 9 pieces as the case may be, has been laid thereon and wedged up securely, the segments of tubbing are built upon it, breaking joints with each other like bricks on edge. Each segment of tubbing has a flange of 4 inches in depth all round it as a support for the wedging. Gluts of pine wood ½ inch thick, are inserted between both vertical and horizontal joints, and each course of tubbing has a backing of wood wedges driven behind it to keep it firmly in place, and to resist the force necessary in driving the joint wedging.

When a number of courses of tubbing have been set up in place, then all joints are wedged up; that is, small wedges of red pine are inserted in the glutting and driven in until the wood becomes compressed so hard, that the chisel edge cannot any longer be driven into it.

Air would collect behind the tubbing, and by its elasticity under pressure, would subsequently tend to blow out some of the wedging. To guard against this, there is a brass 4 inch valve placed in each crib at the back of the tubbing, to allow the air to pass freely from the lowest to the highest lift. Also each segment of tubbing has a hole of 1¼ inches diameter through its centre, to let the air escape during the process of wedging; these holes are plugged when the wedging of the joints is completed.

The quantity of tubbing used in shutting off the feeders of water in the shafts was considerable.

In the C, or pumping shaft, 284 feet in depth were tubbed in 5 lifts, using 40 segments of cribs and 1,128 segments of tubbing, the weight being 569,639 lbs of cast-iron.

In the B, or winding shaft, 273 feet 4 inches in depth, were tubbed in 4 lifts, using 36 segments of cribs and 1,233 segments of tubbing, the weight being 658,724 lbs.

In the staple shaft, 283 feet inches, were tubbed in five lifts, using 25 segments of cribs and 711 segments of tubbing, the weight being 323,975 lbs.

This quantity of tubbing, over 776 tons, of 2,000 lbs. to the ton, in all, was cast at our own colliery foundry and consumed 419 tons of pig iron, imported from England, and 419 tons of scrap cast iron obtained in this country.

As there were 19,923 linear feet of joints in the tubbing to wedge up, and as about 24 wedges were used for every foot, it can be seen that quite a quantity of pine timber had to be cut up for this purpose, as well as for the glutting.

I may add that, finding the untubbed portion of the pumping shaft beginning to waste away, owing to the disintegrating action of the water from the pumps and the heat from the partially condensed exhaust steam from our haulage engines, we have, during the last two years, lined other 309 feet in depth of that shaft with cast iron tubbing. This was put in three lifts, using 340 segments of cribs and tubbing, weighing 388,316 lbs.

This tubbing, not having to resist a pressure of water, was made lighter than what had been previously put in above, the joints were not wedged further than was necessary to keep the tubbing in place, and the cavities in the sides of the shaft behind the tubbing were filled up with fine gravel from the beach.

Again during February last we lined the sump portion of the staple shaft for eight feet two inches in depth with tubbing, using 27 segments or 8,121 lbs. in width.

Thus altogether a depth of 1,158 feet eight inches of these shafts have been lined with cast iron tubbing weighing 974½ tons.

The pumping shaft is fitted up with buntons and guides for the cages by which the colliers and others descend and ascend to and from their work. The buntons are placed at intervals of six feet apart vertically in the shaft. In casting the tubbing this was kept in view and pockets were formed on the segments at proper intervals to receive the buntons. This was found to make a much better job than the plan before adopted of having to spike cleats to the wedging of the tubbing for the reception of the ends of the buntons.

I omitted to state above that in casting the tubbing the thickness of the plate or back is made to correspond with

the pressure it has to bear; for the lowest lift, where it had to withstand the head of 284 feet of water, it was made ⅞ inch thick and was reduced as it ascended and had less pressure to bear.

DISCUSSION.

MR. H. S. POOLE said that the experience at Sydney Mines would be valuable to others who had to adopt this method of keeping back water. He remembered going down the shaft and seeing the stream of water that was coming in. He would like to ask Mr. Brown what per centage of the tubbing broke under the hammer when the sections were being tested, preparatory to putting them in.

MR. R. H. BROWN replied that he did not think any was broken in that away. Some sections were spoiled by cinders getting in when the metal was being melted. They had a first-class foundryman, and a great deal of the credit for the success was due to their engineer.

MR. H. S. POOLE mentioned a thrilling experience in connection with this mine. A tub was going up with a man in it and caught on the edge of a bracket when it was 70 feet from the bottom. The man was thrown out and fell to the bottom of the pit, landing on his feet, and, singular to say, without any serious injury.

MR. R. H. BROWN said there was no doubt that the man fell the entire 70 feet. He was laid up some three weeks with sore ankles but, otherwise, escaped injury.

MR. W. BLAKEMORE, (Cardiff) said that he was pleased to have heard such an eminently practical paper. In England the greatest difficulty arose not in passing through wet rock, but in going down through running sand, of which there was a great deal in the old country. Before tubbing was resorted to, it was extremely difficult to get through it. He remembered one pit in Staffordshire that they were working at for ten years. In that case they drove piles around the shaft as best they could. This was superseded by tubbing in connction with piling. He knew of one case where wooden tubs were used, but where there was any considerable depth the only system was that of cast iron tubbing. He would like to ask whether at Sydney Mines the tubbing had been tested by hydraulic pressure?

MR. R. H. BROWN replied that it had been tested only by hammer.

MR. BLAKEMORE said that in 1873, in England, a Belgian process had been tried. The bed of coal to be reached lay under conglomerate and the cost of sinking was very great. The sinking was done without pumping the water out. The implement used was a huge crossbar filled with as many as 20 or 30 steel drills, 3 feet in length, and two inches in diameter. This apparatus was continuously dropped and hoisted again. By this process a shaft 170 yards deep was sunk through heavily watered conglomerate and the core bored out, leaving a clear cylinder. The process was perfectly successful in carrying the work down, and in achieving all that the Belgian engineers claimed for it. When they got into dry ground the tubbing was let down a little at a time until the whole was lowered to the bottom and seated in the dry ground. The company had expended £110,000, and were anxious to get coal as quickly as possible, and when they got 6 or 9 feet into the dry strata they wanted to know if that was not enough. The engineers wanted to go down much deeper, but when they got down 12 feet the company commenced to blast at the bottom, and the force of the blasts combined with the pressure of the water had such an effect that the next morning the water was at the surface, and there it was to-day. Although experimentally the system was correct, it was not an economic success and would never be repeated. Since then shafts had been sunk in the same way that Mr. Brown had described. This had been done with perfect success and at half the cost of the Belgian process. It was gratifyng to him to learn that the same difficulties which were met with at home were successfully dealt with here, and in the way that was regarded in England as the best possible.

MR. CHAS. ARCHIBALD said that in the district that here presented, they were not troubled so much by the quantity of water as by its quality. It was too acid.

MR. H. S. POOLE said he understood that at one of the pits of the Dominion Coal Company, Mr. McKeen had adopted the plan of building up a wall of cement to keep back the water.

MR. DAVID McKEEN, M.P., on being called upon, said that there was not much to relate. When they got to hard rock they found that there was a large inflow of water, and decided upon walling the shaft with concrete. The work was carried through very successfully, and it was believed that it would be perfectly tight and substantial. The shaft was 24 feet long, and 10½ feet wide. It was intended for hoisting coal and lowering and hoisting men, and for taking down compressed air pipes for ventilation purposes. He was interested in Mr. Brown's paper as one of the most valuable seams of coal of the Dominion Coal Co. was near the sea shore. In connection with their work generally he would add that the Stanley coal heading machine had been used with very satisfactory results. It cut a very complete roof and there was little danger of the roof coming in. Besides this it was found that coal could be cut and delivered at a less rate than if taken out of the ordinary boards. The machine was driven by compressed air and he thought it would work quite a revolution in our mines. The coal could be cut in six foot tunnels and put into the tubs for 22 cents a ton where the miners were paid 41 cents. In some places 60 cents was paid. That did not include interest on capital. If the Society could make it convenient to meet in Sydney next summer he believed he was voicing the sentiments of all who were interested in the mines in saying that they would be pleased to show members who came the works and seams, and he believed that there would be novelty enough about it to make it interesting.

MR. R. H. BROWN said that he would be most happy if the Society would come down.

MR. B. T. A. BELL at the same time took the opportunity of inviting members of the Society to attend the meeting of the General Mining Association of Quebec at Montreal on the 11th and 12th of January.

The Asbestos Fields of Port au Port, Newfoundland.

By C. E. WILLIS, Halifax.

The metamorphic rocks, and serpentines, of the Eastern Townships of Quebec, and the Gaspé Peninsula, in which the Canadian asbestos, or more correctly speaking chrysotile, is found, dip under the Gulf of St. Lawrence, appear again on the west coast of Newfoundland, and extend many miles inland, probably entirely across the island, though in places, especially on the great elevated central plateau, they are capped with granitic rocks, and seemingly have disappeared.

Here and there, also, are great mountains of magnesian limestone, and in the region of the Grand Lake, and other isolated sections, are found carboniferous basins, with small seams of very good bituminous coal. Still this entire area, extending about 100 miles north and south and the entire width of the island east and west, can be safely called a sepentine country, and contains according to Mr. James P. Howley's estimate, 5097 square miles of serpentine rocks.

The region is exceedingly rugged and picturesque. Cut by deep gorges and ravines, with towering and precipitous mountains, and craters of extinct volcanoes, with streams and lakes of the most crystal clearness, and everywhere cascades, of from a few feet to many hundreds of feet in height, combine to make a district of surpassing grandeur and interest, not alone to the mining engineer, but to anyone who loves nature in its wildest moods.

The serpentines, with the granulite dykes which everywhere intersect them, contain vast deposits of minerals, and are to-day nearly virgin fields, except on the immediate coast line, for the prospector and miner, and certain to become in the immediate future, the seat of great mining operations.

That the country has not long ere this taken a first rank as a mineral producer is due to its former isolated position, difficulty of access, except in small sailing vessels, and other ulterior causes; but now, with regular and frequent steam communication, the prospector and engineer are forcing their way into the country, and soon it will be the scene of prosperous mining camps, and a large mining industry.

The minerals met with are copper, which is found everywhere, magnetic hæmatite chromic and specular iron ores, coal and petroleum, gold, silver and lead, nickel, iron pyrites, antimony, marbles, gypsum, mica and asbestos; and it is to the latter that I shall devote a few remarks.

The existence of asbestos in this great belt of serpentine has long been known, or supposed, and several well known geologists, in their writings as far back as ten and fifteen years ago, have predicted that it would be discovered in quantities sufficiently large to be of economic value, but it has only been within the past three years that the attention of the miner has been turned in this direction, and it is now attracting much interest in the island.

On the eastern coast of Port au Port Bay, rising out of the sea to a nearly vertical height of 1,800 feet, is a mountain known as Bluff Head.

This mountain determines the southern boundary of the serpentines.

For many miles north the coast line is precipitous and lofty, culminating at Cape Gregory in a bluff nearly 2,500 feet high.

At Bluff Head, and extending for about one mile north, the beach is composed of conglomerate, very hard, and highly polished on the surface by the action of the surf which breaks upon it. The beach is strewn with bowlders of all sizes which have fallen down from the cliffs, and nearly all of them contain seams of asbestos, while the conglomerate of the beach itself is filled with it.

It was here the asbestos first really attracted much notice.

Long known to the fishermen of the neighborhood as "cotton rock," it came to the knowledge of the Hon. Daniel Cleary of St. Johns, who, some three years ago, equipped a small expedition to do some prospecting in the neighborhood.

The success met with was so immediate and marked, that other claims were immediately secured, till in a short time some 30 square miles were taken up by prospectors, and speculators, and the past summer has witnessed a large amount of development work.

Much of this work has been of the most satisfactory nature to the owners, and proves the field to be a large and valuable one, but from my observations a very large part of the district now held under leases and license, will be valueless as far as asbestos is concerned, but this always is the case in a new mining country where speculators rush in and secure claims, without having previously been on the ground.

About one year ago I visited the district, and secured claims on what promised to be valuable asbestos ground, and with this as a basis to start on, the Halifax Asbestos Co., Ltd., was organized.

The property consists of two areas of 640 acres each, each containing one square mile, and situated on both sides of a deep gulch or ravine, the dividing line being lengthwise through this gulch.

The ravine mentioned runs in nearly a true north and south course, from the shore inland for about five miles, where it is cut at right angles by the valley of the Fox Island River, and terminates at the inner end in this valley.

The sides of the gulch are very precipitous, having more slope where we have been working this summer than elsewhere, and rise to an elevation of 1,700 feet on one side, while on the other they in places reach to a height of over 2,000 feet. The walls are nowhere, I think, in the entire length of the valley, less than 600 or 700 feet high. It might be said of the property, that it is an ideal one for mining, as no hoisting engines or pumping will ever be required in the future operations of the company.

The claims are about three and one-half miles from the sea by the gulch, though but little more than two miles in a straight line from the shore; we will, however, reach the shore in the future through the valley of the Fox Island River, which, though it makes a somewhat longer route, brings us to the shore at a fine shipping point, and admits of the building of a road with very easy grades, in fact none whatever to speak of.

The government of Newfoundland being keenly alive to the necessity of fostering its mining industries, has undertaken to construct a good road by the route we desire, to connect with the point of shipment, the government railway, now under construction, and the settlements of Port au Port and Bay St. George. This road will accommodate all the claims in the district.

Active development work was started on the 7th July and continued till late in October, with the most satisfactory results. The work extended over many hundreds of feet along the gulch, and some ten or twelve large cuts were made in the mountain side, through the surface drift. In each opening quantities of asbestos was found as soon as the rock was reached, while the surface drift, which varies from three to twelve feet in depth, is everywhere filled with loose fibre, entirely free from the matrix, the result of the decomposition of the serpentine, through the action of the frosts and weather.

The fibre runs up to 2½ inches in length, and is of the most beautiful quality, and difficult to distinguish from the Canadian product.

In fact, the peculiar green tinge of the asbestos, the color and composition of the serpentine, the granulite dykes and many other geological peculiarities, go to prove the remarkable similarity of this region with the Eastern Townships of Quebec, where the Canadian chrysotile mines are located. The company is much pleased with the success which has met its first efforts, and will begin mining operations on a large scale in the early spring.

In many places where the cliffs are denuded, seams of asbestos can be seen running through the rock, and as these exposed places can be found from the foot to the top of the hill, it proves the entire mountain side to be asbestos bearing.

There are three remarkable water-powers on the property, from any one of which a head of from 1,000 to 1,200 feet can be obtained to operate power drills and necessary machinery for dressing the short fibre.

While we have been developing our property, we have had as neighbors the Newfoundland Mineral Syndicate, an English company, who own the areas next our own, who started operations a short time previous to our beginning.

They also have met with most satisfactory results, and I was informed by the engineer in charge, they were more than satisfied with their season's work. Their areas also contain very large deposits of copper, hematite and specular ores. One vein of specular, some 20 feet wide, is cut in many places by seams of asbestos, which, to myself at least, is unique, and I should be glad to hear if such a thing has heretofore been observed.

A large amount of work has also been done on the Cleary claims, where a like satisfactory result has been met, while owners of other areas have been looking over their ground, and have done some prospecting on a small scale.

The summer's work proves the value of the field beyond question, and it will at once come to the fore as a factor in the world's supply.

Labor is abundant and cheap, and supplies can be readily obtained, and landed from vessel within a short distance of the mines.

With water transportion at hand for the product, cheap labor, and being much nearer the European markets than the other sources of supply, will enable the operators to successfully compete with mines in other countries.

DISCUSSION.

The Chairman asked Mr. Fletcher whether any rock of a similar character had been noticed at Cape North, C.B.

MR. HUGH FLETCHER said that he had listened with much pleasure to the paper read. In reply to the question asked by the President, the chrysotile found in Nova Scotia differed from that described in the paper in being derived from hornblende and in not being true asbestos. It was found between Sydney and Louisburg in Cape Breton, and also on the north side of the Bay of Fundy, at Harrington River, and at Lynn. He thought that the fibre was too short to be of any economic value, and that the rock was found in too small quantity. His attention had been called by Mr. John Rutherford of Stellarton, to the occurrence of asbestos in the trap rock

at Clementsport on the Bay of Fundy, Mr. Rutherford examined it, but did not see a sufficient quantity.

MR. B. T. A. BELL said it had given him great pleasure to hear Mr. Willis' description of this new source of asbestos. The paper would be scanned with much interest in England and in the United States. The Canadian asbestos industry as they all know, was confined to a comparatively small area in the Eastern Townships of Quebec, and had for a number of years provod highly remunerative, although during the past two years owing to competition from other sources the prices realized had fallen very considerably. Italy, Russia and South Africa, were each contributing to the world's supply, but he ventured to say that the quality of the fibre from these countries was vastly inferior to that produced in Canada. The sample of crude from South Africa on the table would illustrate the great inferiority of that product compared with Canadian, yet manufactured goods were being made from it and sold in England at one-half the cost of Canadian and Italian. A new source of asbestos is also reported to have been found in Arizona in United States. So for, however, the quality of the asbestos from these different fields is of much lower grade, and we doubt not but that the Canadian product will continue to hold its position of first place against all other competitors. Murray in one of his reports to the Geological Survey, pointed out many years ago the likelihood of asbestos being found in economic quantity in Newfoundland. Dr. Ells of the Survey had also more recently visited the colony, but he was not aware that his report had been published. He had seen samples from the Cleary mine, Port au Port Bay, but developments there and indeed at any of the mines had not yet demonstrated that any serious fears need be entertained by the Canadian producer of the quantity or quality of asbestos to be produced from this new source.

MR. JOHN J. PENHALE (United Asbestos Co.) Black Lake said that he heard of the Newfoundland asbestos two years ago, but the people who were looking into it then were not so frank as Mr. Willis. He had seen samples taken from the Newfoundland deposits and thought they were good, and somewhat similar to the Canadian samples. He understood that the work done so far had been purely of a preliminary character and that nothing but the surface deposits had been opened up. It should be remarked, however, that experience had shown that no material improvement in quality was found at depth, the fibre being much the same.

A National Museum Wanted.

MR. B. T. A. BELL—Those of the members of the Society who participated in the proceedings of the Mining Convention at Montreal will remember that one of the resolutions unanimously adopted there related to the necessity of larger and more adequate accommodation for the magnificent collection of the Geological Survey at Ottawa. The building was not only too small for the wants and uses of this most important branch of the public service, but its surroundings endangered its destruction by fire. Only during the past few days the building had been found to give indications of falling in and a force of men were at work putting in additional support. The time had arrived when the Dominion Government should provide a building more suited to the requirements of this valuable public collection. The Boards of Trade in Upper Canada were pressing the matter on the attention of the authorities, and he thought the Society might contribute its influence to the same end. He would move a resolution to that effect and that a copy of it be forwarded by the Secretary to the Hon. the Minister of the Interior and also to the various members of Parliament in the Province.

MR. JOHN HARDMAN seconded the motion which was carried unanimously.

McGill Mining Society.

At the second annual meeting of this Society, October 5th, the following officers were elected :—Hon. President, B. T. Harrington, Ph.D. ; President, W. A. Carlyle, Ma.E. ; Vice-President, A. A. Cole, B.A. ; Secretary-Treasurer, O. C. Hart.

All of the meetings (every second Thursday evening) have been well attended, and very interesting and practical papers have been read by gentlemen actively engaged in mining and metallurgical work. The blackboard has always been freely used to illustrate with sketches the subject under consideration, and many questions have been asked that led to discussions. The first paper was given by Mr. Mathewson, Superintendent of the P. S. and R. Works, Pueblo, Colo., one of the largest smelting works in the west, on the "Smelting and Refining of Silver and Lead." The western methods were succinctly described, beginning with the sampling and purchase of the ore from the miners, the "bedding" of the various classes of ore so as to make the best mixtures for smelting in the blast furnaces, the operation and habits of those water-jacketted furnaces, the treatment of the resulting "base bullion" and slags, the refining and production of certain by-products. Mr. Mathewson is a graduate of McGill and is known in the west as a very successful smelter-man, having worked up from assayer to his present excellent position.

The next paper was on "Coal and Coal Mining in Montana," by Mr. H. Walker, B.A.Sc., of this college, late engineer for the G.N.R.R., at their coal mines at Land Coolie, Mon. With a sketch map of the west on the board, Mr. Walker first gave some idea of the vast extent of the coal measures in the west and the amount of mining work being done. The coal is in the formation of the Cretaceous age as in our Canadian North-West and though containing 15·20 per cent. ash, makes a good fuel for steam purposes, and in parts for coking, but this coke is not nearly as good as that from the eastern ovens as it is not as strong and bright and crushes easily in the furnace. The system of mining is by "board and pillar," good mining plants are erected, and all of the coal is burned after screening, all of the slack or culm being used under boilers, or in the large Brückner roasting furnaces. Mr. Walker also described the great copper-silver reduction works lately completed at that now famous town on the Missouri river, Great Falls. A large dam across the river gives almost unlimited power, and with coal from Land Coolie at $1.50 per ton, the copper-silver ores from Butte are now being treated at a great reduction in price. These heavy sulphide ores, after being crushed, are roasted in a battery of the largest sized Brückner roasters, reducing the sulphur from 30·40 per cent. to 8·11 per cent., and then the calcined ore is smelted to matte which is run, when at a very high heat, into converters like those used in producing Bessemer steel. The product of this copper-Bessemerizing is copper 98·99 per cent. pure, a product hitherto unattainable with so few operations, and the pigs of this copper are then treated electrolytically by a secret process with so pure results that this copper now ranks in the markets next to the famous "Lake" copper from the Lake Superior mines.

Mr. C. B. Kingston, B. A. Sc., of Aspen, Colo., at our third meeting, gave a very interesting paper on "Silver Mining in Colorado." First the geology of that region in which the great mines of Leadville and Aspen lie, was explained, it being shown that these vast ore bodies of silver and lead are found in the lower carboniferous limestones in close relation with intrusive shuts and dykes of porphyry or igneous rock. Mr. Kingston is connected with the "Della S. Mining Co." of which Mr. D. W. Brunton, one of the finest mining engineers in America, is manager, and the lecturer was able out of his experience in this large mining work, to clearly discribe the various methods of extracting the ore, of timbering and prospecting. Much of the mining is being done, or was before the price of silver dropped out of sight, by leasers or tributers who bid for the different sections, *i.e.*, offered what royalty they would be willing to pay besides doing a certain amount of prospecting work and doing and keeping all work in good order. It is claimed of one eager Swede that he bid 110 (?) %. This method of mining is found to have many advantages, if the leasers are held by well-termed leases and then carefully looked after. The mine is developed at a lower cost than otherwise possible and still many of these leasers make very good pay.

In another larger mine in Aspen, this plan has been found to give great satisfaction to both mine owners and miners. The mine furnished transportation for ore and waste, candles, powder, etc., at cost, or at much less than the men themselves could obtain ; the men were bound to do a certain amount of development work, and if no ore was found, an agreed but low price was paid for such work so that the work was not an entire loss to the men. The scale of royalties increased with the value of the ore mined as determined at the public sampling works. By giving the leases only to good steady miners, and then on fair and reasonable terms, adjusted every month to its conditions, the mine was worked by good men in the best possible manner, as they felt the company was doing the best by them, and with such profitable returns as had never been got before. Mr. Kingston returns to Aspen as soon as its mines open up again which will be when the miners realize that they must work for less than $3 for an eight hour shift.

Mr. Whiteside, a fourth year undergraduate in mining read the fourth paper, on "Coal and Coal mining in Pictou County, N.S." This paper showed that the writer had kept his eyes and ears open while working in these mines during the summer last past, and he was able to tell and describe much of great interest relating to the nature of these coal seams and the excellent mining being done in some or all of these properties. It might be said here that on a paper similar to this one, Mr. Whiteside has been lately awarded the prize of $25 given for the best essay on mining or chemistry work done during the summer vacation. All the meetings are well attended, and certainly with profit to our mining students who are thus brought into greater knowledge of the mining work being done in those mining centres, where many of them will yet be engaged.

C.

Screens at the Levant du Flenu Collieries—The screening arrangements at the Levant du Flenu collieries in Belgium are capable of dealing with 600 to 700 tons of coal in ten hours. The screening device consists of two superimposed screens, both 15 feet long by 4 feet wide. The upper screen is composed of bars set ⅝ inch apart, centre to centre, and the lower is of steel plate perforated with ½ inch holes. The screens are hung by two pairs of rods at an angle of 13°, and are vibrated at a low speed by a connecting rod. Three sizes are made, and the coal is received from the screen on two travelling belts which deliver it into trucks. The belt for the larger size is adjustable in height at the tail end, so that the coal is not broken by falling into the waggons—*Colliery Guardian*, vol. lxiii., p. 699, one illustration.

Canadian Iron Manufacturing Industries.

The following comparative statement showing the status of the various iron manufacturing establishments of the Dominion has been kindly furnished the REVIEW by Mr. George Johnson, Dominion Statistician. The figures are given in advance of the last Census Report, now in preparation.

INDUSTRIES.	Establishments.	Employees.	Wages.	Value of Raw Material.	Value of Products.
Agricultural Implements	221	4,543	$1,812,050	$3,139,966	$7,515,625
Blacksmithing	9,404	12,069	3,193,646	2,717,352	9,028,116
Boiler Works	30	450	163,884	468,225	877,819
Car and Locomotive Works	19	5,018	2,215,524	4,640,043	9,460,525
Ra'w'y Switches, Etc	1	34	10,400	22,000	35,000
Cutlery	12	81	29.525	25,100	74,300
Edged Tool Works	40	873	326,744	490,368	1,071,604
Engine Works	18	1,257	534,091	653,516	1,575,159
Fireproof Safe Works	7	180	79,000	47,050	187,950
Fittings and Foundry work in Iron, Brass, Lead, Etc	53	1,374	554,420	1,120,755	2,192,200
Foundry and Machine Work, Stair Mfg. included	625	12,918	5,178,357	6,867,392	16,285,680
Gun Making	41	67	19,947	17,705	56,150
Lock Making	23	194	78,155	60,660	171,150
Nail and Tack Factories	12	405	152,000	457,600	744,150
Rivet Factories	1	30	10,560	49,000	70,000
Rolling Mills	6	2,006	843,500	1,896,834	3,163,930
Saw and File Cutting	18	333	140,232	237,441	537,680
Scale Factories	9	126	47,565	82,930	170,200
Screw Factories	2	17	6,980	8,000	19,200
Sewing Machine Factories	12	897	295,953	193,853	790,870
Spring and Axle Factories	8	242	100,420	185,470	378,600
*Steel Making	.....	.....	.....	.....	.....
*Steel Barb Fence Factories	.....	.....	.....	.....	.....
Tin and Sheet Iron Works	226	1,339	443,606	873.012	1,893,841
Wire Works	50	871	331,473	958,355	1,973,660
Totals	10,848	45,315	16,568,032	25,214,227	58,273,400

* Under other heads.

The Duty on Explosives, Etc.—Interview with the Premier at Halifax.

On the 11th instant, in accordance with resolution, a deputation from the Mining Society of Nova Scotia had an interview with the Right Hon. Sir John Thompson and Sir Charles H. Tupper at Halifax on the subject of the duty on explosives, its carriage on Government railways, and the importation of mining machinery. Sir John Thompson and his associate took much interest in the views of the Society as presented by the deputation and at his request the following memorandum of the case was prepared and forwarded to Ottawa :—

The Right Honorable Sir John S. D. Thompson, Premier of the Dominion of Canada :

The Memorial of the undersigned humbly showeth :

In accordance with your permission the committee from the Mining Society of Nova Scotia, whom you so kindly received on the 11th inst., at Halifax, beg to present their petition in writing. On the subject of dynamite, which is the explosive exclusively used in the prosecution of the gold mining industry in this province, we are compelled on account of the excessively high local cost to ask your Government to give us some relief in the way of a reduction in duties, and to have this article carried as freight over the Intercolonial Railway as it is upon all other railroads throughout the continent. To make our handicapped situation clear to you we take the liberty of quoting selling prices of dynamite in the United States, and in other parts of the Dominion. Prices in the United States, delivered f.o.b. vessel New York or Boston for an article carrying from 40% to 75% nitro-glycerine guaranteed, 12 cents to 19 cents per lb. The prices in Ontario and Quebec for 35% to 50% nitro-glycerine guaranteed, and delivered f.o.b. cars at St. John, N.B., are 12 cents to 18 cents per lb., while the Nova Scotia manufacturers prices are from 30 to 50 cents per pound and no percentages of nitro-glycerine guaranteed or named, much of the stuff sold being of a very inferior quality. The duty of five cents specific and 20% *ad valorem* per pound, making nearly 60% duty on the first cost, and the restriction on the rails gives the local sellers a monopoly, and makes our case peculiarly hard—our industry therefore suffers, and we are convinced that its future success depends chiefly, if not entirely, on the working of our large belts of low grade ores, which will not permit of the use of a high priced explosive. Could we obtain the article here at the same price as it is obtainable everywhere else, the number of men employed in the industry would quickly be increased, as the cost of explosives is the heaviest next to that of labor.

While this hardship refers more particularly to gold mining, it also applies to iron and all other branches of mining in Nova Scotia apart from coal.

We therefore earnestly desire you will give us that relief that consistently lays in your power. We might say, while we claim the danger of transportation by rail of dynamite is reduced to a minimum, we desire you would submit this question to scientific investigation. The privilege of conveyance granted us would we believe, prevent the practice of small consumers, in spite of the vigilance of officials, carrying it over the road in their grips.

We also submit some points which we hope may assist in proving that *wrought iron pipe* in sizes over two inches and not manufactured in Canada, should be admitted as mining machinery under the Act.

Large wrought iron pipe is used in coal, gold, iron and other mines as both suction and discharge pipes to the pumps, and the pumps would be of no service whatever without such pipe. The pipe is just as necessary to the pump to enable it to free the mines from water as the coal would be to the boilers in order to generate steam; in fact the pumps are utterly useless without the pipe.

All mines, in Nova Scotia at least, are at considerable depth, and trouble from water is a very serious difficulty—pumps of from 4 to 6 inch suction and pipe of the same size is what is generally used, therefore large quantities of the pipe is imported and the duty which is imposed is a very serious tax upon the industry employing an army of labourers and millions of capital. We therefore respectfully submit that the free entry of the pipe should be allowed as a fair interpretation of the Act which allows mining machinery not made in Canada, to be admitted free.

A number of letters bearing on this subject from the managers of coal and other mines were sent some time since to the Controller of Customs, and a perusal of the same will show you that their sentiments are heartily in accord with ours on the subject.

Dated at Halifax N.S., December 20th, 1893.

G. W. Stuart,
M. R. Morrow,
Geo. Franklyn,
Wm. Lithgow,
A. A. Hayward,
Geoffrey Morrow,
J. Howe Austen.

Committee appointed by the Mining Society of N.S.

CORRESPONDENCE.

Photography and Mining Reports.

To the Editor of the Review:

SIR,—The art of underground photography has of late made such progress as to deserve the special attention of mining engineers. By its aid they may now illustrate their reports with pictures plainly showing the exact appearance of ledges, ore-bodies and other features of importance. And if the practice of employing such illustrations once become general, the value of mining reports will be considerably enhanced. Indeed, I doubt not that in the near future no mining report will be considered satisfactory if it be not fully illustrated by means of photography.

As an example of the excellent results now obtainable, I send you a copy of a report I have justmade upon the Mayflower and South Mayflower Mines, on the great "Mother Lode," in Amador County, California. This report, as you will observe, is illustrated by some exceptionally fine photographs of points underground; and I trust you will permit me to add that in the event of any of your readers being desirous of having a copy, I shall be very happy to supply the same free of charge, as I think that by so doing I shall be aiding mining engineers in general.

Your obedient servant,

STEPHEN H. EMMENS.

165 Crocker Building,
San Francisco, Dec. 15, 1893.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Quebec.

Township of Templeton.

The property of Wallingford Bros. seems to improve to the depth. About 2 months ago, when the main shaft had attained a depth of 25 feet, the vein crossing the shaft 8 feet in wide, contained a large amount of small crystals. The present dimensions of that shaft are 50 feet deep, 20 feet long, and 10 feet wide, and the vein continuing in a regular width of 8 feet contains a large amount of crystals yielding 4 x 6 feet and over. The average daily output of rough mica amounted to 2 or 2½ tons. 9 miners have been steadily employed since the spring; 5 men are cutting the mica for a large electrical concern at Boston. As the vein shows a regular continuance also in the walls, it may be safe to say, that this mine has to work for a long time to come.

Ontario.

Belmont Township.

Developmets have been steadily continued at the Ledyard Gold mine (E ½ lot 19 in 1st con.) with a force of 8 to 10 men.

The shaft is now down 46 feet and the vein is widening again after having been pinched for a few feet.

The vein has been traced for about 200 yards west of the shaft, where it strikes a large knoll upon which there is an outburst of quartz, into which another vein having a north and south direction appears to run. A considerable quantity of gold-bearing quartz has been obtained in following the veins along the surface, in some parts mixed with sulphurets. The sulphurets are rich in gold, crystals of pyrites having assayed respectively $47, $96 and $127 in gold per ton, and some pyrites not crystallized $210 per ton. About 100 yards west of the knöll a powerful quartz lead, about 100 feet wide, has been discovered which shows the same kind of gold-bearing honeycomb quartz that has been found in other parts of this property. Three tons of ore from the shaft were treated by Messrs. Rickets & Banks, of New York, and produced by actual mill test $25.40 per ton. An analysis was made recently of samples taken from this property, and writing under date of 13th inst., to the Director, Mr. G. C. Hoffman, analyst of the Geological Survey, writes:—

"The sample of ore from the Ledyard gold mine on the east ½ lot 19, in 1st con. Belmont, Peterboro county, has been examined and with the following results:

"The material, which weighed some 25 lbs., consisted of a white sub-translucent rust-stained quartz carrying a somewhat large quantity of iron pyrites. The whole was reduced to fine powder and a fair average sample of the latter submitted to assay. The result showed this particular sample of ore to contain: gold at the rate of 4·608 ounces to the ton of 2,000 lbs.; silver, none."

Lake Nipissing.

Mr. John McKay of Eau Claire is working his lot No. 9 in the 1st Concession, Township of Calvin for white mica. The crystals are irregularly distributed in veins of a coarse granite, which have a general north-east south-west direction, and vary in width from 4 ft. up to 25 ft. One vein with elliptical section shows a length of 110 ft. and an average width of 15 ft. The crystals taken out of this vein have a light green color and the single laminaes contain frequently green spots, they are not very large in size but yield a good average of clear sheets. The vein has been tested by a shaft of 25 ft. depth and it seems to continue regularly. Another vein in the north part of the property has a width of 25 ft. and has been traced for about 450 feet. The output for 3 months with an average labor of 5 men amounted to 3,500 lbs., which have yielded 25 per cent. of trimmed mica.

Mr. F. B. Hayes of Ottawa, has been working for about 2 months on his Lot No. 16, 2nd and 1st Concessions of the Township of Calvin. 6 parrallel veins containing white mica crystals distributed have been uncovered. The principal opening consists of an open cut of 30 feet by 10 feet wide on a mountain slope. Work has been suspended for the winter on acconnt of the heavy snow fall. The quantity and quality of the mica taken out gives reason to believe that the property if developed can be worked with success. Operations will be resumed next spring.

Sudbury District.

Up to December 1st the Canadian Copper Company report that it has produced 300,000 tons of smelting ore, and 40,500 tons of matter equivalent to about 6,500 tons of copper and 5,600 tons of nickel.

British Columbia.

Vancouver Island.

Whilst the removal of duty on coal is regarded with general approbation here, it will not, in the opinion of Mr. S. M. Robins, result in any great improvement in the coal market, as far as Nanaimo is concerned. Mr. Robins has said that until the new tariff goes into force, providing it passes Congress in March next, there will be very little sale for coal and he anticipates very dull times in this line for the next few weeks.

The shipments of coal by the New Vancouver Coal Co. (Ltd.), for the month of November amounted to 20,927 tons.

Kootenay District.

Mr. Pugh and his associates of the San Francisco Pyritic Smelting Company have 14 men at work in the War Eagle mine and expect soon to double the force.

Twenty tons of ore from the Dardanelles mine in the Slocan country came out to Bonner's Ferry a few days ago for shipment to Great Falls, Mont., and twenty tons more will arrive shortly. The first shipment was the fifth carload sent out from that mine. The lowest returns were 248 ounces of silver and the highest 500 ounces.

The men and corporations operating mines in Nelson and Trail Creek districts have cut the wages of miners and laborers from $3.50 and $3.00 a day to $3 and $2.50 a day. No reasons are given for making the cut, other than that any number of miners and laborers can be gotten to work for the reduced wages.

Edward Haney, owner of the Nickel Plate, who is now in the city, states that he would have had a carload of ore ready for shipment November 1st had plans not been interrupted by the accident that resulted in the death of William Varker. He now contemplates shipping ore on the 10th. His shaft is down 34 feet. The vein is about 20 inches wide and the average assay, all the way across, is $105, according to the report of parties sent to Montana to examine it, without any knowledge on his part of their purpose. The lowest assay that he has ever received was $105.40 and the highest $141. It also goes 40 per cent. iron, worth $4.50 per ton and 15½ per cent. copper.

Development work is in progress by William Austin on the Bonanza King, Mr. Aspinwall on the Kootenai Bonanza and John R. Cook on the Consolidated St. Elmo.

The Reed and Robinson group on Four Mile creek was recently bonded by John Finch and Patsy Clark for $40,000. A further bond of $10,000 has been placed by the same parties on the Jenny Lind, an adjoining claim. The Reed and Robinson was bonded by Messrs. Jewett Chadborne for $10,000, on behalf of a London company, but it was dropped at the beginning of the silver slump.

The Silver King has probably more ore ready for shipment than any other mine in Kootenay; that is more ore in ore sheds. It is being brought down to the wharf at Nelson at the rate of ten tons a day. The management has not decided how many tons will be shipped this winter, but if a good rate can be got over the Nelson and Fort Sheppard the shipments may aggregate more than those of any other mine in the district.

The McDonald hydraulic mine, in the Lillooet district, on the Cayuse Creek, was sold a fortnight ago to British capitalists at a figure which is not given to the public, but the McDonald Bros. are supposed to have made a good thing out of the property. Mr. William Tietjen, of New Westminster, has refused $50,000 for a claim he has on the Lillooet. It is understood that a wagon road is to be built in the spring, crossing the river at Spuzzum and thence running up the north fork of Siawash Creek. This will reduce the cost of operating the Siawash Creek claims, which promise large returns to the owners.

The returns from the Le Roi mine of 17 tons of ore shipped to the Tacoma smelter have just been received, as follows: Yield in gold, $42 per ton; cost for mining, $3; transportation to trail from mine, $5; railroad freight and smelting charges, $19; total, $27 per ton, leaving a profit of $15 per ton. This mine is now working 26 men. The main tunnel is in ore, iron and copper pyrites.

Texada Island.

The provincial government has made a grant for roads on the island, and they are now under construction. The roads are 10 feet standard width and will make the mineral claims accessible, and put them in communication with Victoria, Nanaimo and Vancouver. Five claims have recently shipped sample lots of ore to the Mechanical Gold Extractor Company, New York, for mill tests. The veins are generally large, running from 5 feet to 50 feet in width. The last assay from the Nutcracker claim showed 10·56 oz. of gold to the ton.

CANADIAN COMPANIES.

Cariboo Hydraulic Mining Company (Ltd.) has been incorporated at Victoria, B.C., to acquire the placer mining claims, leases and property held by the "Bullion," "Hop E. Tong," "Bonanza" and "South Fork Hydraulic Mining Company, Limited Liability," either for money or fully paid up shares of the company. Also the acquisition by gift, pre-emption, purchase, exchange, or any other lawful means, of any mineral claims, or placer mining claims, or leases, or other mining property, whether the same may be shall by pre-emption, purchase, lease or fee, or howsoever held, for any consideration whatsoever, including, but so as not to restrict the generality of the foregoing words, fully paid up shares in this company and the bonds, debentures, shares, stocks and securities of any other company or corporation. Authorized capital $300,000, divided into 60,000 shares of $5. Head office, Vancouver, B.C. Directors, J. M. Buxton, John M. Lefevre and J. D. Townly.

Nelson Hydraulic Mining Company.—The prospectus of this new B.C. Company has been issued. Capital $100,000, in 20,000 shares of $5, $15,000 being preference

shares entitled to dividends of 10 per cent. The property is to be purchased by the allotment of 9,000 fully paid up shares. Head office, Nelson, B.C. The syndicate at date consists of J. A. Kirk, J. F. Ritchie, R. B. Dongan, F. M. McLeod, John Elliot, J. F. Hume, R. J. Bealey and G. W. Richardson. The property to be acquired is known as the Boulder Placer Claim on Forty-Nine creek, about eight miles from the town of Nelson, B.C. The property consists of one and one-quarter miles in length along the course of the Forty-Nine creek channel, and the banks on either side for a width of 700 feet. The present channel varies in width from 50 to 90 feet, with a probable average depth of 15 feet, filled for the most part with compact gravel, a large portion of which is heavy boulders. The bed rock is a coarse-grained granite, in irregular layers, forming a very uneven bottom, making natural riffles favorable for arresting the coarser particles of gold.

Tests made in an open cut in the channel gravel for a distance of 70 feet gave returns of one-half cent per pan, or about 60 cents per cubic yard. The uneven nature of the bed-rock and the character of the gold distributed through the entire deposit, point to rich deposits in favored places on the bottom.

The channel gold is heavy, of a flat, angular shape, comparatively coarse and of a character to save in the sluices. The rim bars, or banks, on either side are in places extensive deposits that vary in depth and extent, in some places showing a depth of from 40 to 60 feet, and extending over several acres.

Samples taken from over a large area including the surface sides, and foot of the banks, and the surface of the channel, gave an average of 20 cents per cubic yard.

Pictou Charcoal Iron Company, Limited.—At a meeting of the board of directors of the Pictou Charcoal Iron Company, Ltd, held at the Vendome Hotel, New Glasgow, Messrs. Jas. D. MacGregor and M. H. Fitzpatrick were elected members of the board. Subsequently Mr. MacGregor was elected President. D. R. Grant finding that his mercantile business at Bridgeville required his whole time, tendered his resignatian as Secretary-Treasurer, and A. C. McDonald, of Pictou, was appointed in his place. This company having secured the celebrated Grant property of Bridgeville, spent some $80,000 in erecting the necessary plant extensive enough to produce fifteen tons of charcoal pig iron per day. After the furnaces had been in operation some months the company discovered that it was necessary to secure additional capital in order to carry on the work successfully. The matter was placed in the hands of G. R. Chisholm, of the Merchants' Bank, Pictou, who successfully disposed of $50,000 of the company's stock assuring immediate resumption of the work on a sound financial basis.

The Middle River Alluvial Gold Mining Co., (Ltd.) is applying for charter of incorporation, under the laws of Nova Scotia. Authorized Capital, $5,000. Directors: J. A. Watt, Halifax; E. J. Treen, New Glasgow; A. D. Ross, New Glasgow; F. W. Wright, New Glasgow; and Jas. McArthur, New Glasgow. Head Office: New Glasgow. Formed to acquire, purchase, hold, possess, lease, convey and transfer mines and mining properties, and natural deposits of gold and other minerals, rock, ore, quartz and earth bearing gold, and gold and other mining areas, licenses, rights and privileges, in the County of Victoria, or elsewhere in Nova Scotia.

The deductions drawn from these tests were: (1) the gold is more readily extracted than the silver; (2) under the same conditions the percentage of extraction is increased —(*a*) by the fineness of the pulp—(*b*) by the duration of treatment—(*c*) by the strength of the cyanide solution; (3) the greater the amount of cyanide added to the ore, the higher will be the percentage of extraction, but in this case the total values extracted for each pound of cyanide consumed are less than when a smaller amount of cyanide is used for each ton of ore treated; and (4) when the same amount of cyanide is used for each ton of ore treated the percentage of extraction is greater when the weight of the solution is equal to that of the ore taken.

His conclusions are that there are no flattering indications of the process being a metallurgical success with the pyritic ores under consideration. With high-grade ores, which are under no circumstances adapted to this process, the percentage of extraction under the most favourable circumstances is low, lower even than the results obtained by amalgamation. However, the total values extracted for each pound of cyanide consumed are relatively high.

With low-grade ores, even where the low value of the tailings will admit of their being thrown away, the total values extracted in a majority of instances are less than the cost of cyanide consumed, to say nothing of milling expenses. In these experiments the percentage of potassium cyanide varied from 0·5 to 1·5 per cent. The treatment lasted from 12 to 60 hours. The extraction of the gold ranged from 2·31 to 84·62 per cent. The extraction of the silver varied from *nil* to 88·88 per cent. The proportion of the potassium cyanide added per ton of ore represented from 5 to 60 lbs., and its consumption rose from 3·2 to 50·8 lbs. per ton. The lowest value extracted per lb. of cyanide consumed was 0·28 dollar and the highest 53·72 dollars. The latter result was obtained in treating an ore which assayed 145·90 ounces in gold and 458 ounces in silver per ton.

Modern American Rolling Mills.

The first rails were rolled in the new Edgar-Thomson mill in 1888 (Iron Age, vol. xlviii, pp. 882-884). The blooms on their way from the blooming mill to the rail mill pass through re-heating furnaces. The rail train is divided into three sets, the first two with three high rolls, the last with but two, all of 24-inch pitch, each set being driven by its own engine, and provided with automatic tables. In the first or roughing rolls five passes are made. The bloom is then carried by driven rollers to the second or intermediate train, in which it receives five more passes, and is then carried to and through the finishing pass in the two-high set. These trains are placed in echelon and far enough apart to permit three 30-foot rails to be rolled. The mill is a very simple one, and has many mechanical arrangements which make roll-changing the work of but a few minutes, while every part of each set of rolls is easy of access. After the rails leave the cambering machine, they are carried down the hot bed by power, and automatically distributed to the cold straightening presses. This arrangement is simple, substantial and inexpensive in operation. The mill has made 781 tons of rails in twelve hours, 1,558 tons in twenty-four hours, and 33,181 tons in one month.

The old blooming mill has been replaced by a 40-inch mill which rolls ingots weighing 4,500 lbs. into 7-inch blooms in nine passes. This mill has an auxiliary feed-table which is placed in front of the table of the train. An ingot is placed upon this table while the one preceding it is being rolled. As soon as it leaves the last pass, the ingot waiting on the auxiliary table is fed to the train table by simply raising the former, thus saving the time which is otherwise lost in getting the next ingot into place on the feed-table. This saving is stated to be as much as 15 per cent. A number of other modifications have also been introduced among which is a simple device for causing one waggon to pass another on the same track. It consists in placing at the point where the two waggons meet a track section, the two legs of which form an obtuse angle, and which rests on trunnions at a sufficient height above the stationary track to allow one waggon to pass clear under it. One set of legs of this false track rest upon the stationary track at the upper portion of the incline, thus causing the descending waggon to mount it, while the ascending waggon is passing under it on the stationary incline track. As soon as the descending waggon has got beyond the trunnions, its weight tops the false track until the other legs rest upon the lower part of the incline track, the tipping at the same time clearing the way for the ascending waggon. The waggon once passed, the balanced track resumes its original position.

The South Chicago rail mill is divided into two sections, each having two sets of rolls in three-high housings, its section being driven by its own engine, and provided with automatic tables both before and behind the rolls. These trains stand in echelon with the blooming mill, which is a 40-inch three-high train. The rail mill rolls are of 27-inch pitch.

In this mill the practice is to cast the ingots in the ordinary upright position, and then to charge them into gas-fired soaking-pit furnaces of the Forsyth-Hainsworth type. After the ingot is reduced in the blooming mill it is carried by power rollers towards first the rail-train, and through a shear by which the end which as the top of the ingot is cut off and the long bloom sheared in two, each half making two or three rails, according to weight of intended section. The first half at once passes through the rail-roughing rolls, the second one being held for a few seconds, or until the first has made three passes, when it is also sent forward. If from any reason the bloom when sheared should have become too cold to be safely and successfully finished, a power over head traveller is provided to carry it at a right angle into a wing at the side of the mill, in which heating furnaces are placed, with a Wellman charging and drawing crane in front of them. When sufficiently heated the same crane conveys the steel back to the table rollers.

By this arrangement cold cobbles or other rail blooms can be heated and delivered to the rolls. In the roughing rolls the bloom receives five passes in three-high rolls. It is then passed to the second roughing tables, and is given three passes in three-high rolls. The partially formed section is elevated to the rear tables of two-high rolls, and making one pass through them, reaches a dummy table in front, from which it slides down on to driven rollers, and is by them carried back to the three-high set of rolls, which are in line with the first roughing rolls and driven by the same engine. In these it receives four passes, making in all thirteen rail-mill passes. It is now a finished section, long enough to cut into three 30-foot rails. This is done at one operation by four saws. After passing through the cambering machine the rails are carried by power down the hot beds. When sufficiently cool they are taken to the cold straightening presses, and are unloaded on to the beds by an automatic arrangement of arms and levers which receive their power from steam taken from the locomotive boiler.

The Shenandoah rolling mill in Virginia is intended for the manufacture of muck and bar iron. The plant comprises a puddling furnace building, containing 12 double-puddling furnaces, each being equipped overhead with a return tubular boiler, 54 inches in diameter and 18 feet long, pierced by 18 flues 6 inches in diameter. The furnaces are arranged for both natural and forced draft. The squeezer is designed for the delivery of an 8-inch bloom, being operated by an independent engine 20 by 20 inches.

The muck mill is a two-stand three-high 22 inch train, driven by a 30 by 48 inch engine. The muck shear is driven independently by a 9 by 12 inch engine. An overhead travelling crane is provided over the roll train to facilitate the changing of rolls, &c.

The bar mill department consists of an 18 inch and a 10-inch three-high train, the former containing two stands and the latter four stands of rolls. Each mill is driven by an independent engine, that attached to the 18 inch mill being 30 by 48 inches, and that connected to the 10 inch mill being 20 by 24 inches. Cooling beds are provided for each mill, and the shears are driven by independent engines. The shear engine for the 18 inch mill also drives the underground saw used in connection with this mill. To simplify the handling of rolls a travelling crane is provided over the bar mills. (Iron Age, vol xlviii, p. 1072, with plan of mill.)

An illustration is published (Ibid, vol. xlviii, p. 921) of a taper-rolling machine which will roll 1⅝ inch metal to any length of taper, and to an extreme width of 5½ inches. On the front of the machine is a sliding table for squeezing and straightening the blank. This table is operated by a cam projection formed on the side of the gear driving the upper roll through a pinion on the shaft carrying the driving pulley. The stroke of this table is adjustable. The lower roll of the machine is driven by gear from the upper one. The faces of the rolls are so formed and so placed in relation to each other as to give the ends of the blank the taper desired. This action of the rolls spreads the ends and increases the width of the plate; the excess being removed by the sliding table moving transversely in front of the rolls as described above. The machine performs the operations of tapering, squeezing, and straightening at one heat.

In 1882 Mr. Garrett patented and built a wire rod mill arranged to take a billet of a large enough section to permit its being rolled direct from the ingot without any re-heating. He decided upon four inches square as being that size. To accomplish this he went beyond the Belgian mill by introducing three separate trains of rolls, placed in echelon, and driven at progressively increasing speeds. Hence the billet rolls could run at all speeds suitable for the workmen to handle the billets without interfering with the speed of the finishing trains. This arrangement not only permitted the use of the larger billet, but made it possible to have several distinct pieces in the rolls at the same time. The present practice is four pieces, and sometimes five rods will be reeled off simultaneously. (Iron Age, vol. xlviii., p. 883, 1892-i.)

In the Gautier rolling mill the billets are heated in two open hearth furnaces. The 10-inch train is driven from a tandem compound Southwark engine by belts. The mill consists of one 18-inch roughing train, and one 10-inch train with seven sets of rolls, and an inclined disappearing floor. The bars are delivered to a Baldwin stretcher; from this they pass to a rotary cooling rack and straightener, and thence to the cooling beds. Between the shipping department at the end of the mill and the mill itself is a depressed line of rails, bringing the waggon to the level of the mill. This track is crossed by four drawbridges, so counterbalanced that they can easily be moved by hand. For heating the mill the Sturtevant system has been adopted. (Ibid, vol. xlviii., p. 1062.)

The West Superior rolling mill contains two trains of rolls. One train, driven by a reversing engine, consists of separate stands of roughing and finishing plate rolls, 30 by 90 inches. The other is a three-high train of 20-inch rolls, intended for a varied product, embracing I-beams up to 12 inches, channels up to 12 inches, angles and tees of all sizes, flats up to 8 inches by 1½ inch, and rounds and squares up to 4 inches. To render this train of rolls as automatic as possible, feed tables are used to handle the ingots and slabs, and power tables carry away the completed plates to the shearing shed. The structural mill is a 20-inch train with housings of extra strength, having both top and bottom screws. When rolling the larger sizes of beams and channels steel roughers will be used, the ingots for such work having been previously bloomed down on the roughers of the plate mill. Owing to the varied product of this train, an automatic feed could not be arranged, but an overhead mechanism has been provided, which supports and largely directs the movements of the hooks on either side of the rolls. The hot beds are arranged like those of a steel-rail mill, with driven rolls and power traverse for the more expeditious handling of the product. (Iron Age, vol. xlix., p. 197).

Surely not Dobson—The Salmon river miners are having a quiet laugh over the fact that it cost Gorkow, the Spokane brewer, $7,000 to discover the difference batween a graduate from a school of mines and one from a penitentiary.—Nelson *Tribune*.

Large Crystals of Canadian Mica—At the World's Fair the exhibit of mica from Canada took first place, the Lake Girard Mica System, of Ottawa, being notably to the front with a magnificent collection of large sized crystals. Probably the largest crystals—certainly the largest the REVIEW has ever seen—have lately been taken out of the mine now being opened up by Messrs. Clemow & Powell in the township of Hincks. Here are the measurements of some now on view in Ottawa: No. I, weight, 363 lbs.; size, 2 ft. 10¾ in. by 2 ft. 10¾ in., showing cuts, 8½ by 18, 7½ by 16, 7 by 14 and 8 by 9. No. II, weight, 237 lbs.; size, 2 ft. 7 in. by 1 ft. 10 in., showing cuts through, 8½ by 21, 10½ by 16. No. III, weight, 265 lbs.; size, 4 ft. 2 in. by 2 ft. 8 in., showing cuts all through 14 by 24, 4 by 10, 10 by 10. No. IV, size, 4 ft. 1 in. by 2 ft. 8 in.; showing cuts all through, 14 by 26, 4 by 10, 3 by 12, 5 by 7.

Novel Gold Extraction—J. A. McConville, who lives near Butte, Montana, killed one of his chickens, and on cleaning it found some small gold nuggets in the crop and gizzard. Having about thirty more chickens on hand, he began killing and examining them. In each of them he found nuggets, the total amount gathered from the thirty-one being $387.55, an average of $12.50 a head. The gold was sent to a bank and pronounced 18 carat fine. Mr. McConville bought thirty more chickens and turned them out in the goldfield in the vicinity of his hencoop. Later, as an experiment, one of them was killed, and $2.80 in gold was taken from it. McConville expects to be a millionaire—if the chickens hold out.

Making Large Steam Pipes—At the New York meeting of the American Society of Mechanical Engineers, Mr. C. H. Manning read a paper in which he described a method of manufacturing large steam pipes he employed 11 years ago for several thousand feet of 20-inch pipe, with very satisfactory results. The pipe was made of mild steel ¼-inch thick, double riveted, and with die forged flangs ⅜ and ½ inch thick. The pipe was riveted with an Allen pheumatic riveter having 70-inch reach of arms which limited the length of sections. The longitudinal seams were placed quartering 45° from top of pipe, with the laps pointing up so as to be readily accessible for calking. The quarter turns were made of two 5-16-inch sheets curved on a cast iron former, and having a row of rivets along the back and another row along the throat. The tees were made of three sheets, shaped over similar formers, and the rivets were all on the sides. A serious difficulty had been previously experienced in keeping the roundabout joints tight. Leaks had been caused by condensed water being retained by these seams, which caused unequal expansion, as the portions covered by them heated much slower than the unprotected or dry surfaces. This was remedied by making the section conical, and bringing all the laps in one direction, and then laying the pipe on a down grade with the smaller ends the lowest, so that the water ran out. The last course of the pipe was not coned, to avoid having two sizes of flanges. Mr. Manning has never known a riveted pipe to give out under water-hammer, and a hammer that would completely wreck a cast-iron pipe or split a welded pipe would only strain the longitudinal joints of a riveted pipe.

The new plate train of the Wellman Iron Company of Thurlow, Pennsylvania, was started in December, 1891. It has rolls 132 inches in width, is driven by a 40 by 60 Corliss engine, and is served by a 30-ton Morgan electric crane. (Ibid., vol. xlviii., p. 1127.)

A skelp train at Wheeling, United States, with three stands of three-high 21-inch rolls, is being erected at the Riverside Iron works. It is to be driven by a 36 by 48 inch engine. The train is intended to roll skelp up to 22 inches in width, the works making a specialty of slitting skelp to various sizes for use in the manufacture of steel pipes. The train is fed by two heating furnaces having four producers. Their capacity is estimated at three tons per heat and seven heats per day. They are to be served by a crane 26 feet in height with 32-foot jib. (Ibid., vol. xlviii., p. 684).

The new billet mill of the Cambria Ironworks, Johnstown, Pa., is three-high with 26-inch rolls. It is in line with the blooming mill. The heating furnaces are sufficiently large to store two heats if required. The engine has 36-inch and 75-inch cylinders, with an 66-inch stroke, and a 90-ton fly-wheel. (Ibid., vol. xlviii., p. 1062.)

The agreements governing the rate of wages paid in the blooming department of the Columbia Steelworks, Uniontown, Pa., are printed in full in the Iron Age. (Vol. xlviii., p. 684.)

Mining in Cariboo, B.C.—The Slough Creek Co., are going into hydraulic mining, having already landed two boilers at Ashcroft. They will develop early in the spring. One claim, the discovery on Mosquito Creek, paid a dividend of $1,500 to the interest this year, and lots of claims in the neighborhood have paid even better than that.

These are only a few instances which point to a revival of old times in the Cariboo country.

There are about 600 miners in the Cariboo district of British Columbia. Of these it is estimated that 400 are between the ages of 51 and 80, and that the mean average does not vary far from 60. They nearly all went into that country while young men during the early gold days, and despite the many hardships endured, retain their youthful vigor to a remarkable degree. Although many of the members have accumulated snug fortunes, few have ever married.—Kamloops *Sentinel.*

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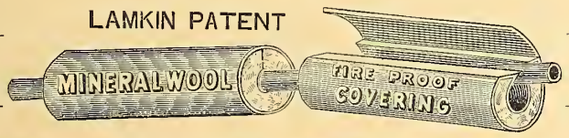

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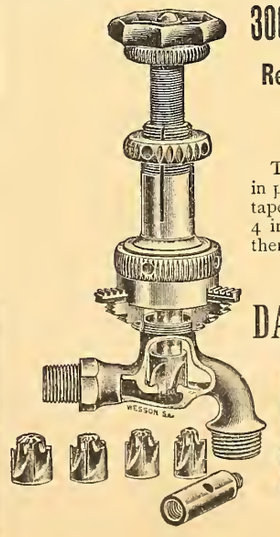

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Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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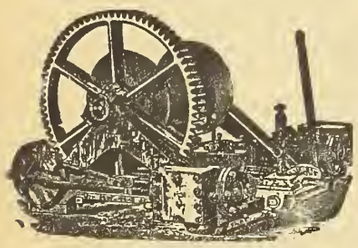

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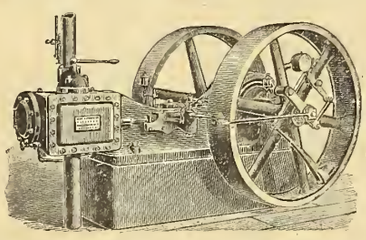

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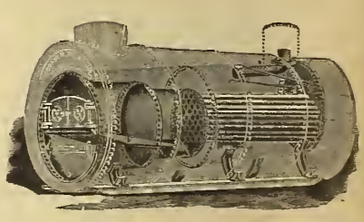

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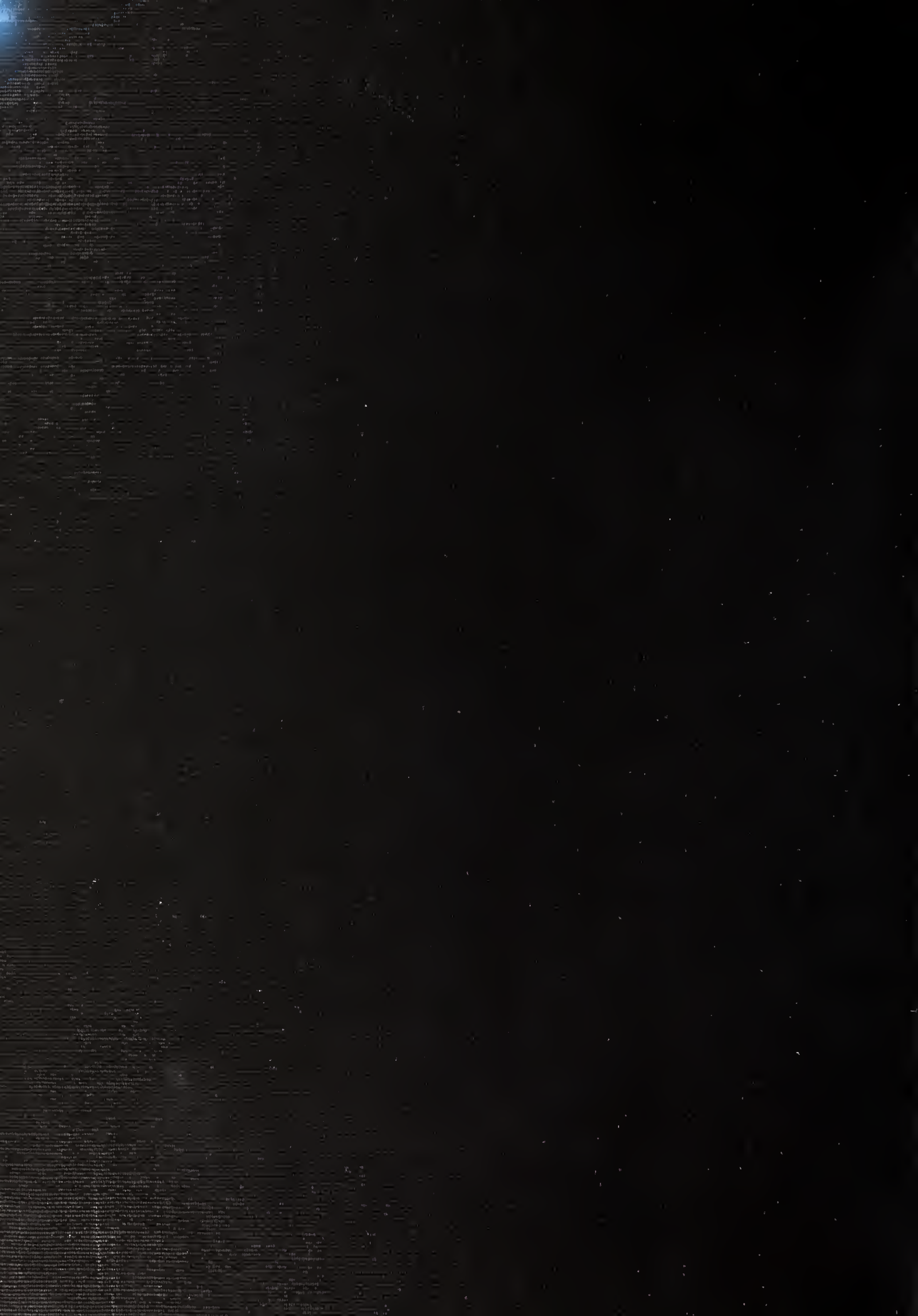
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